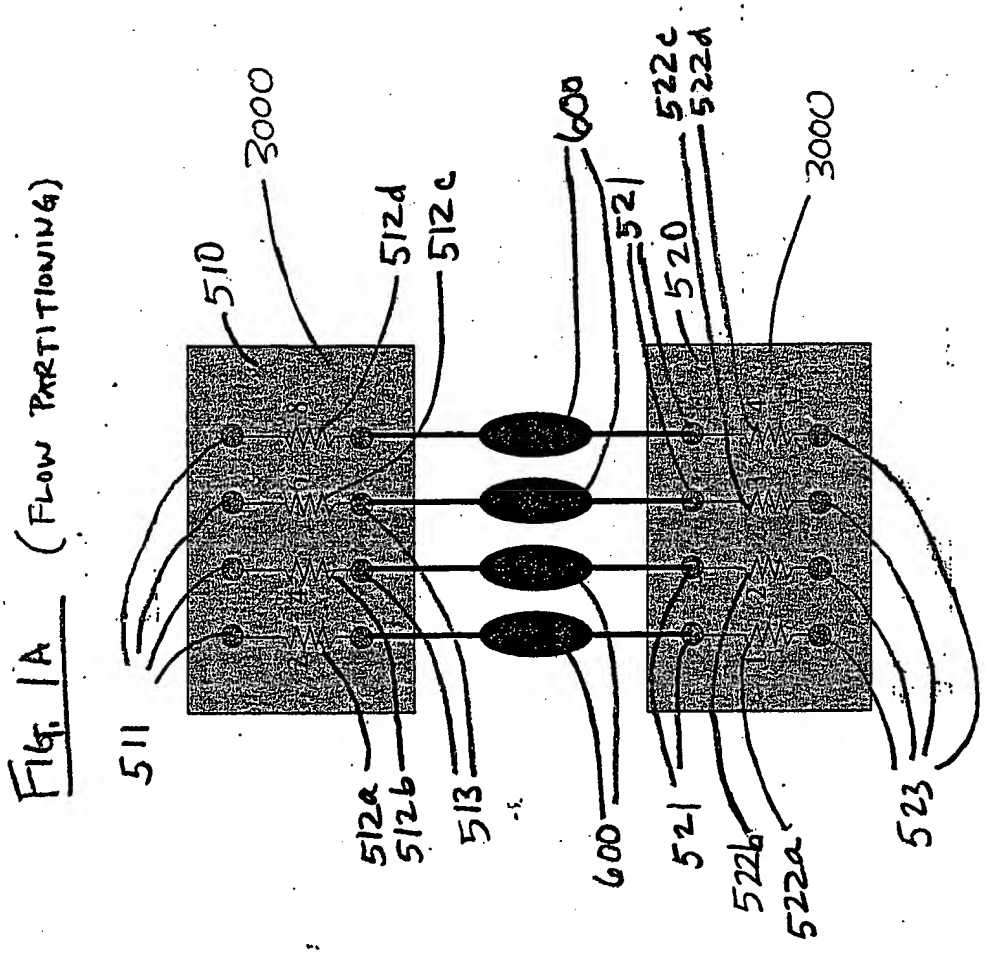


Fig. 1A (Flow Partitioning)

Fig. 1B (PRESSURE PARTITIONING)

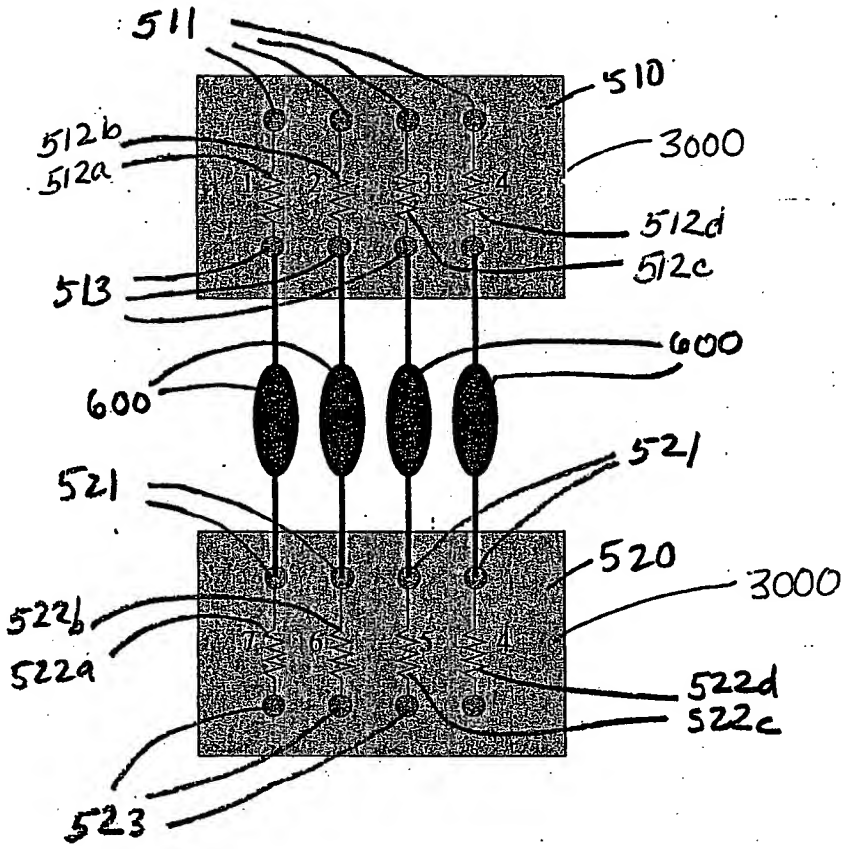


Fig. 1C (FLOW / PRESSURE PARTITIONING)

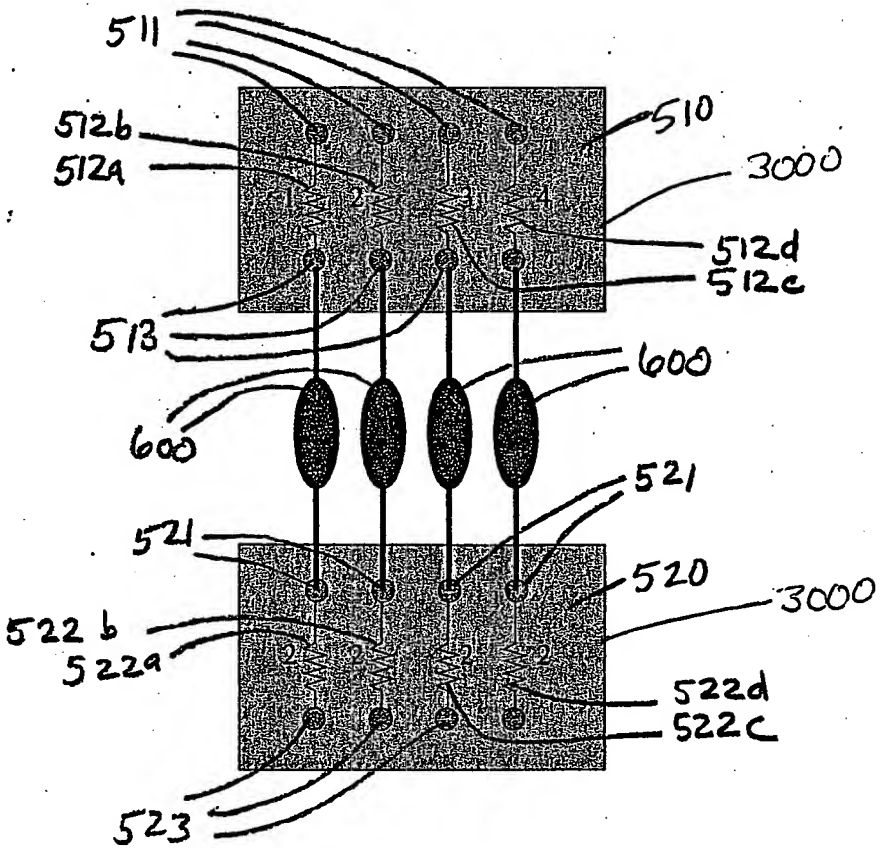


FIG. 2A

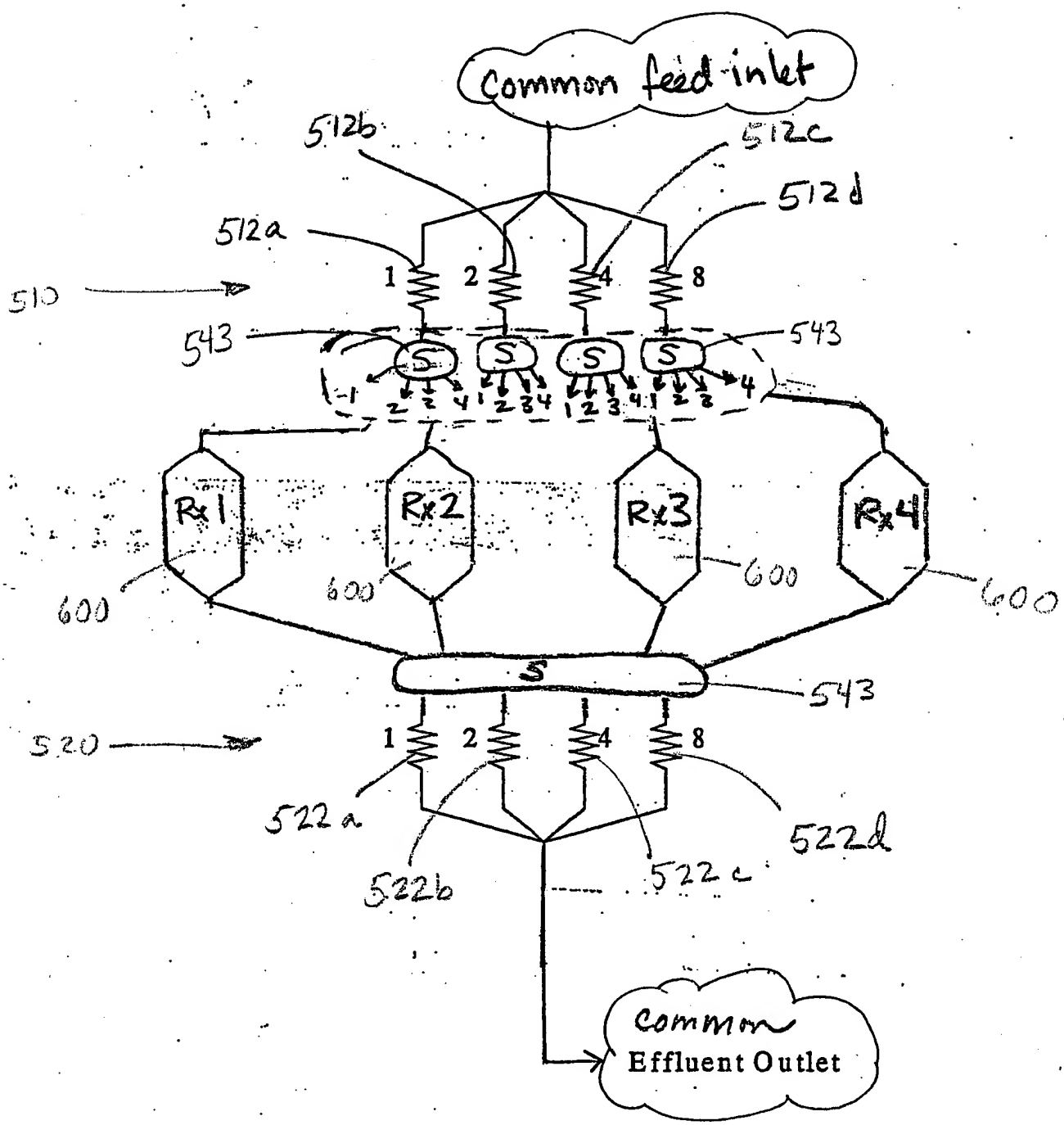

Common feed inlet
512b
512c
512d
512a
1
2
4
8
510
543
543
S
1
2
4
1
2
3
4
1
2
3
4
1
2
3
4
Rx1
Rx2
Rx3
Rx4
600
600
600
600
S
543
520
1
2
4
8
522a
522b
522c
522d
common
Effluent Outlet

Fig. 2B

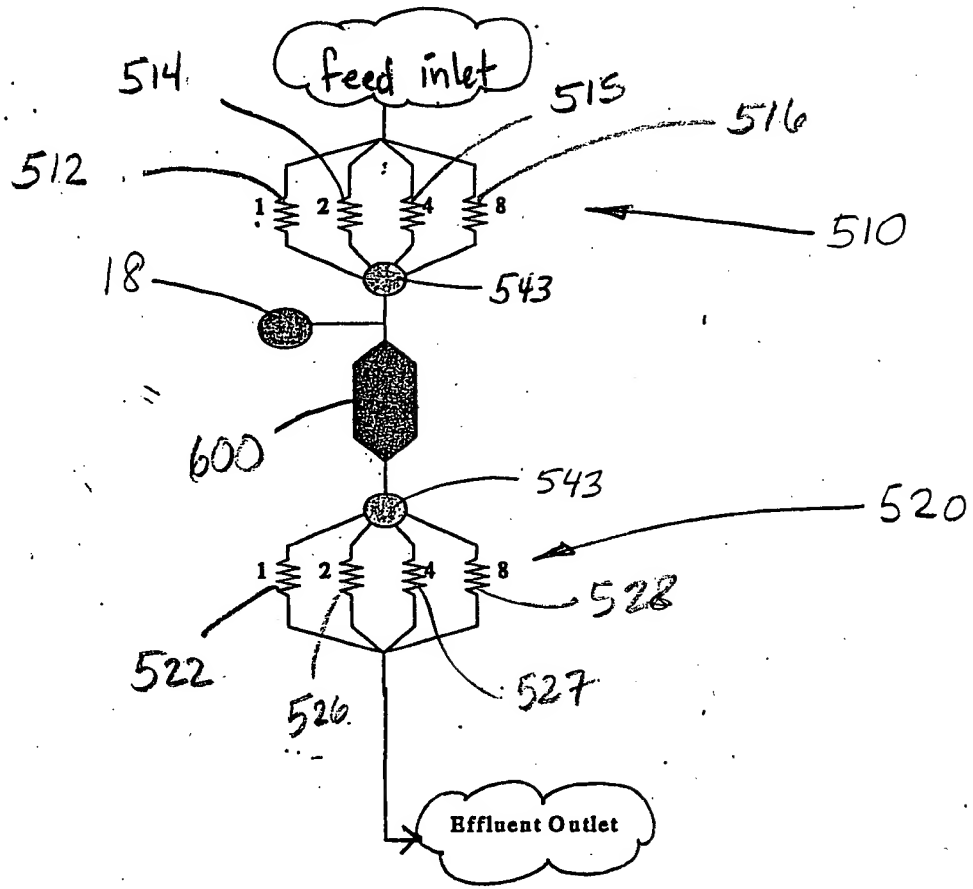

feed inlet
514
515
516
512
1
2
4
8
510
18
543
600
543
520
1
2
4
8
528
522
526
527
Effluent Outlet

Fig. 2C

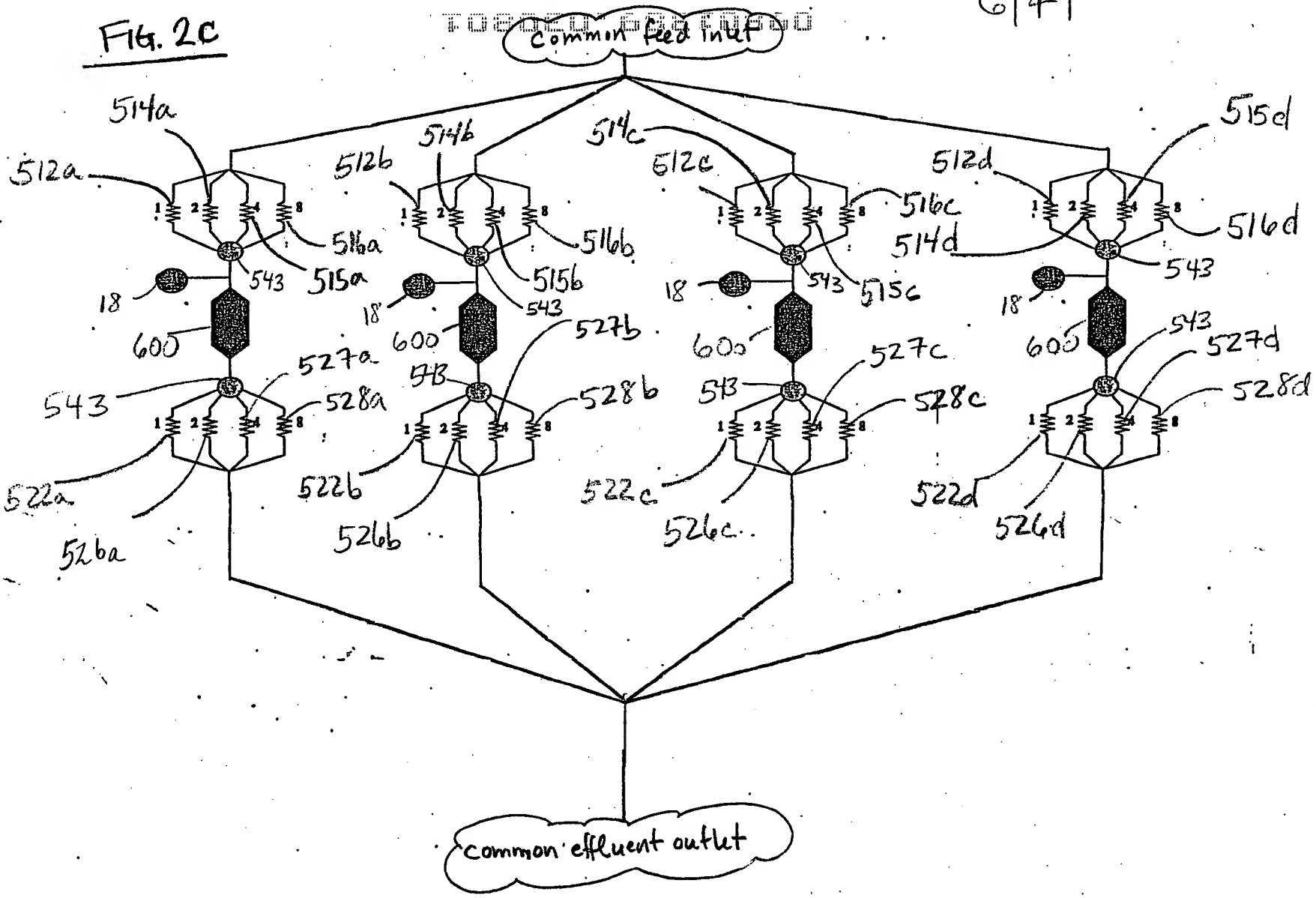

common feed inlet
514a
512a
516a
515a
543
18
600
527a
528a
522a
526a
514b
512b
516b
515b
527b
528b
522b
526b
514c
512c
516c
515c
527c
528c
522c
526c
515d
512d
516d
514d
527d
528d
522d
526d
common effluent outlet

Fig. 2D

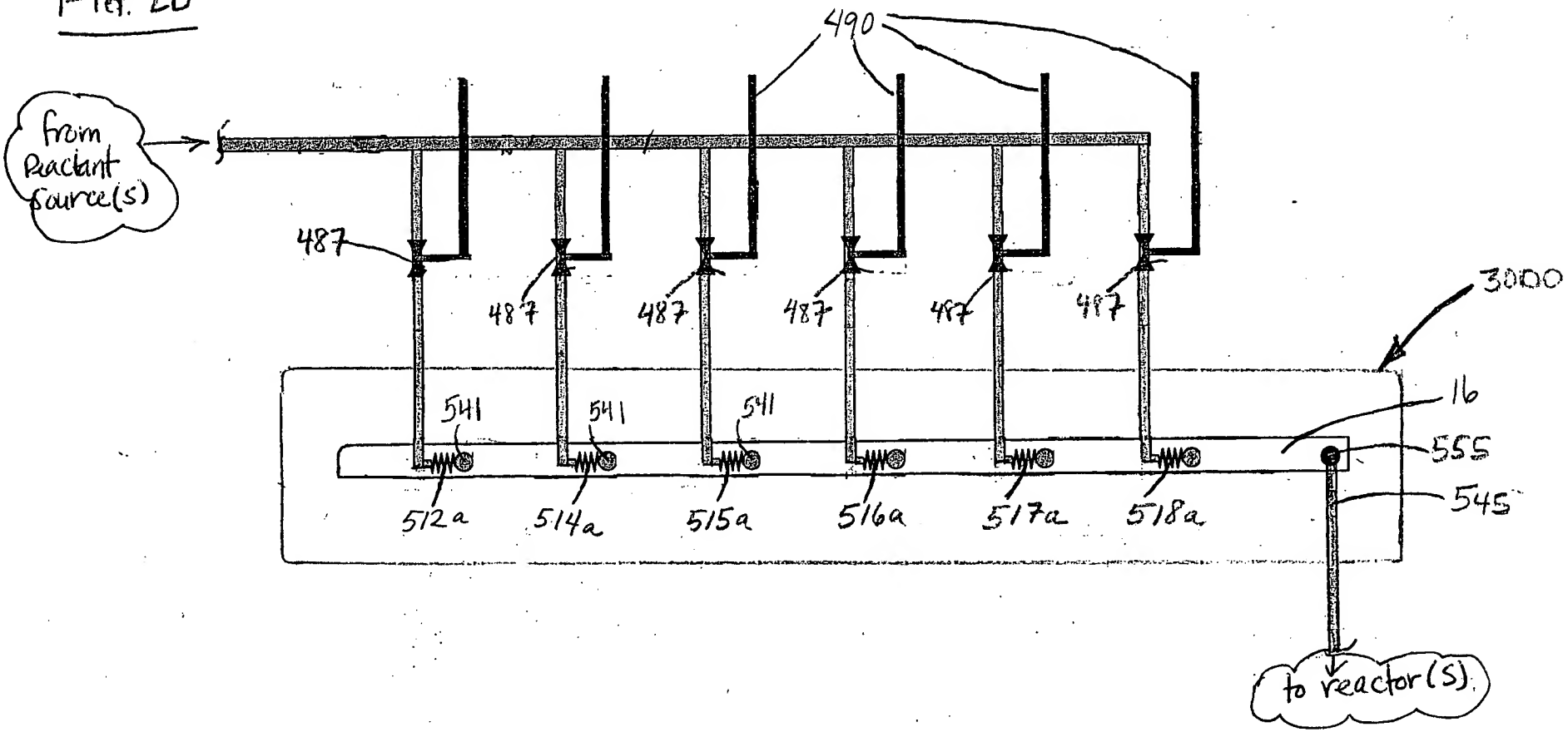


FIG 2E

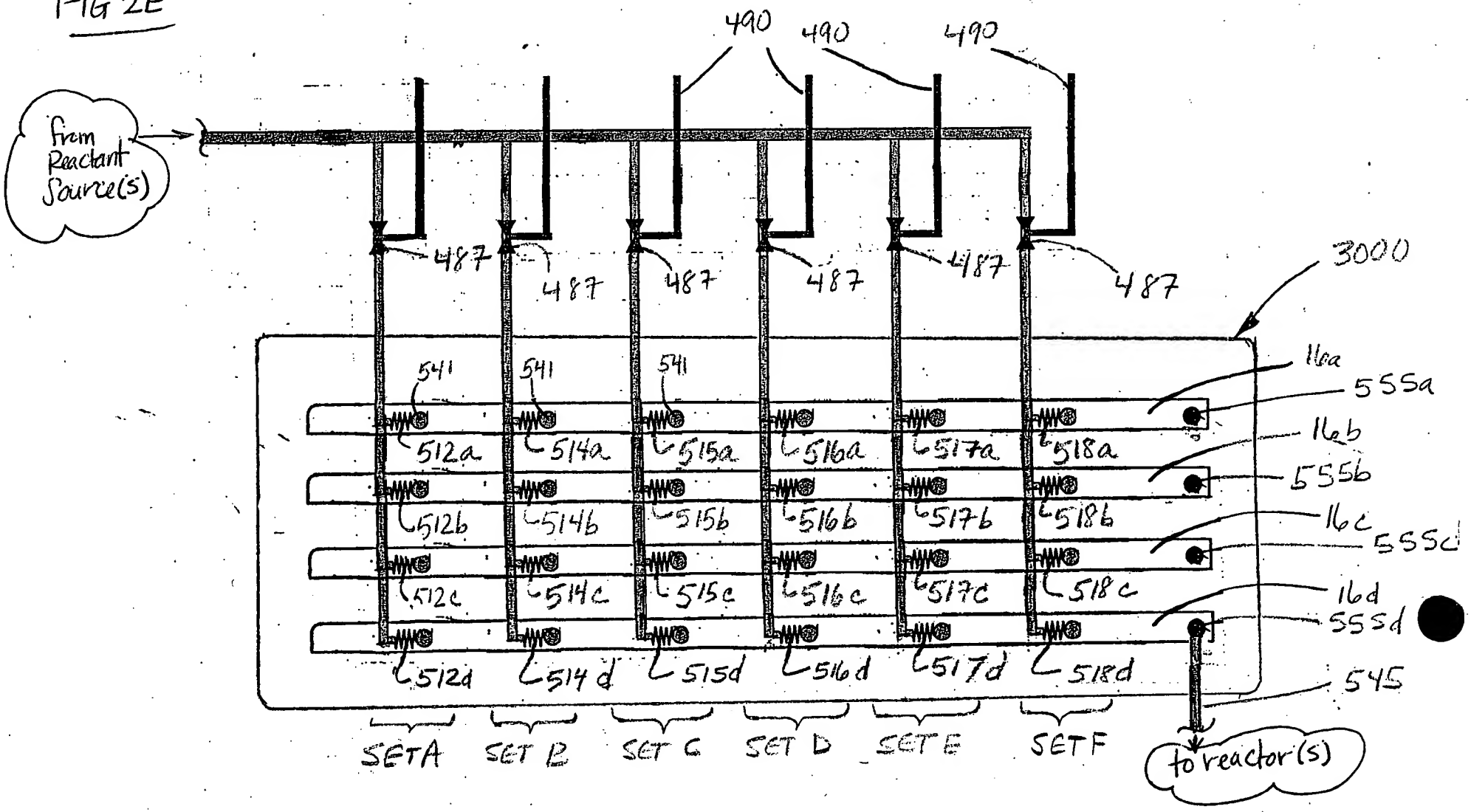

490
490
490
From Reactant Source(s)
487
487
487
487
487
487
3000
541
541
541
512a
514a
515a
516a
517a
518a
512b
514b
515b
516b
517b
518b
512c
514c
515c
516c
517c
518c
512d
514d
515d
516d
517d
518d
16a
555a
16b
555b
16c
555c
16d
555d
545
SET A
SET B
SET C
SET D
SET E
SET F
to reactor(s)

Fig. 2F

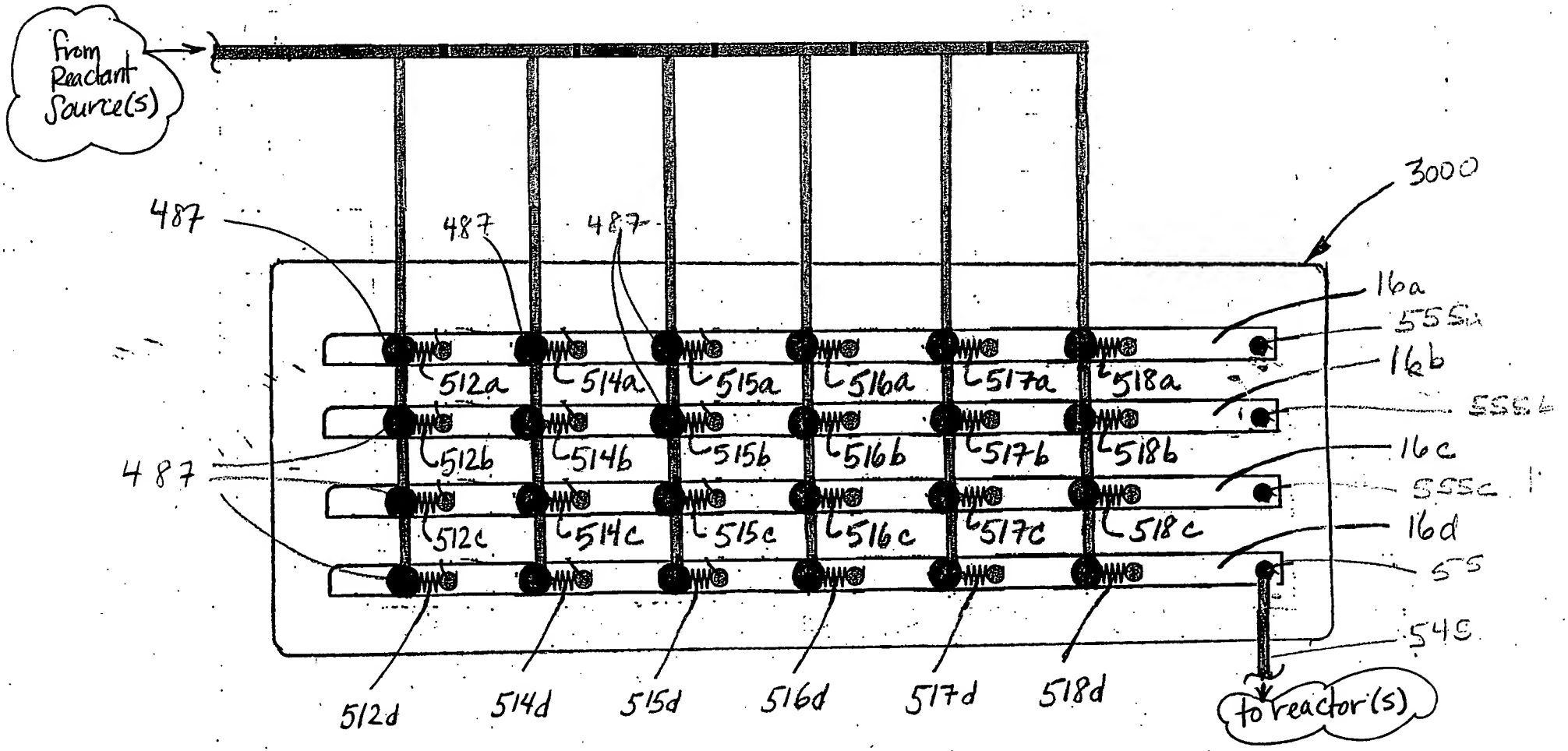

From Reactant Source(s)
3000
487
487
487
487
16a
555a
16b
555b
16c
555c
16d
555
545
512a
514a
515a
516a
517a
518a
512b
514b
515b
516b
517b
518b
512c
514c
515c
516c
517c
518c
512d
514d
515d
516d
517d
518d
to reactor(s)

FIG. 3A

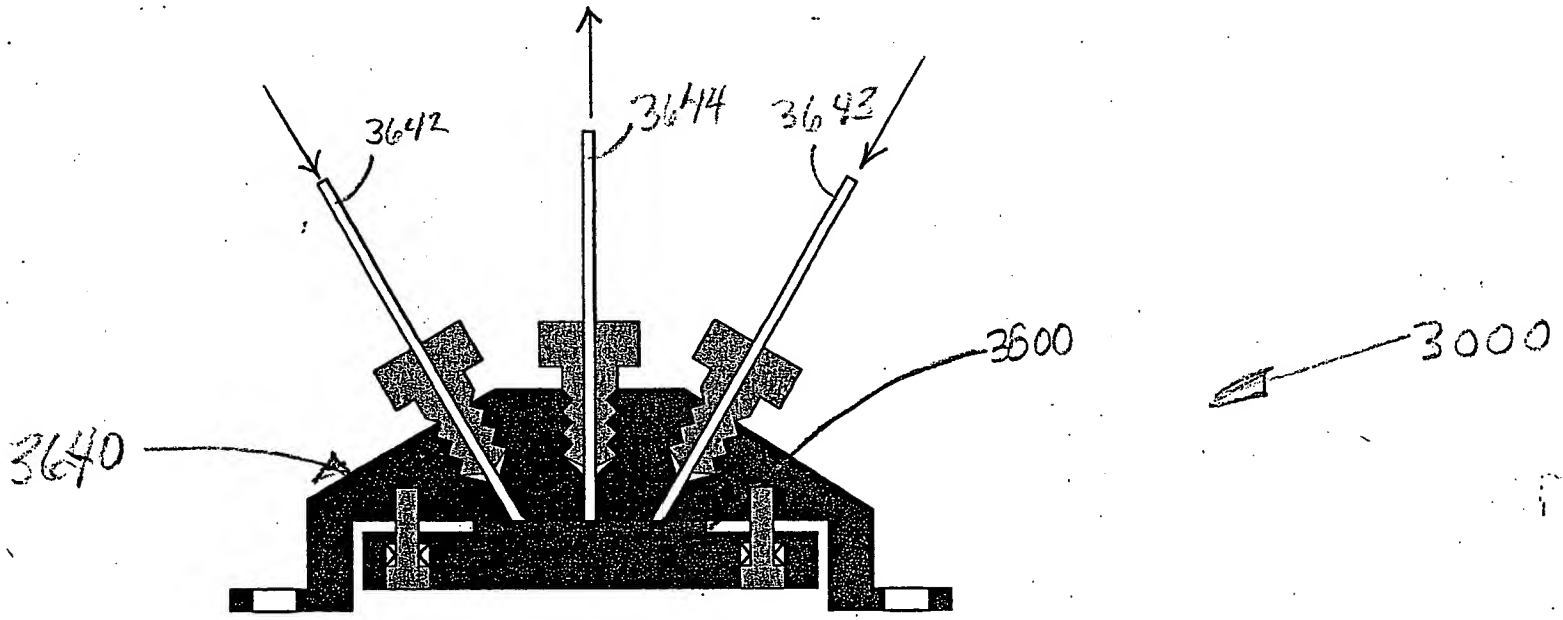


FIG. 3B

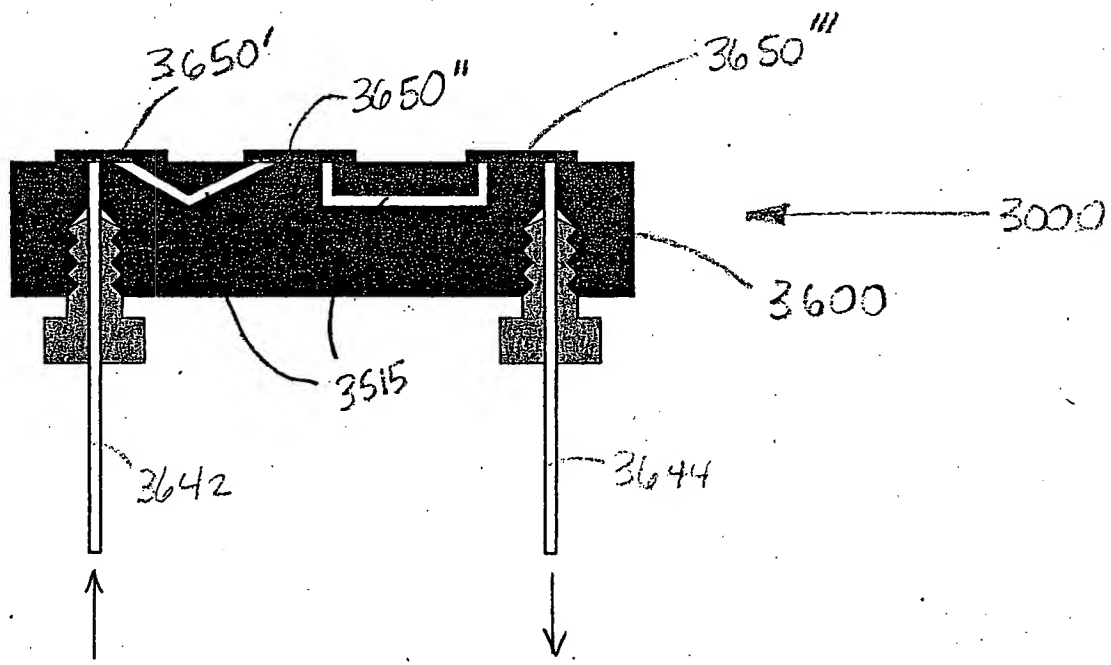


Fig. 3C

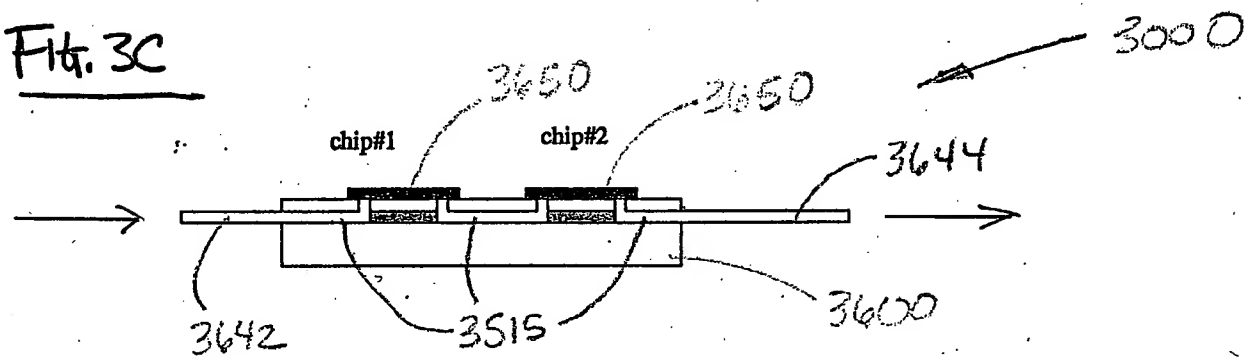

3000
3650
3650
chip#1
chip#2
3644
3642
3515
3600

Fig. 3D

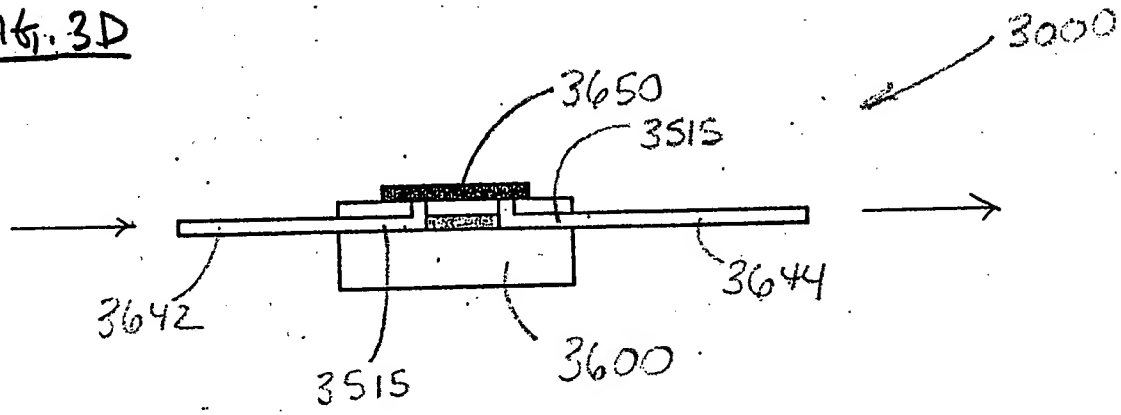

3000
3650
3515
3644
3642
3515
3600

FIG. 3E

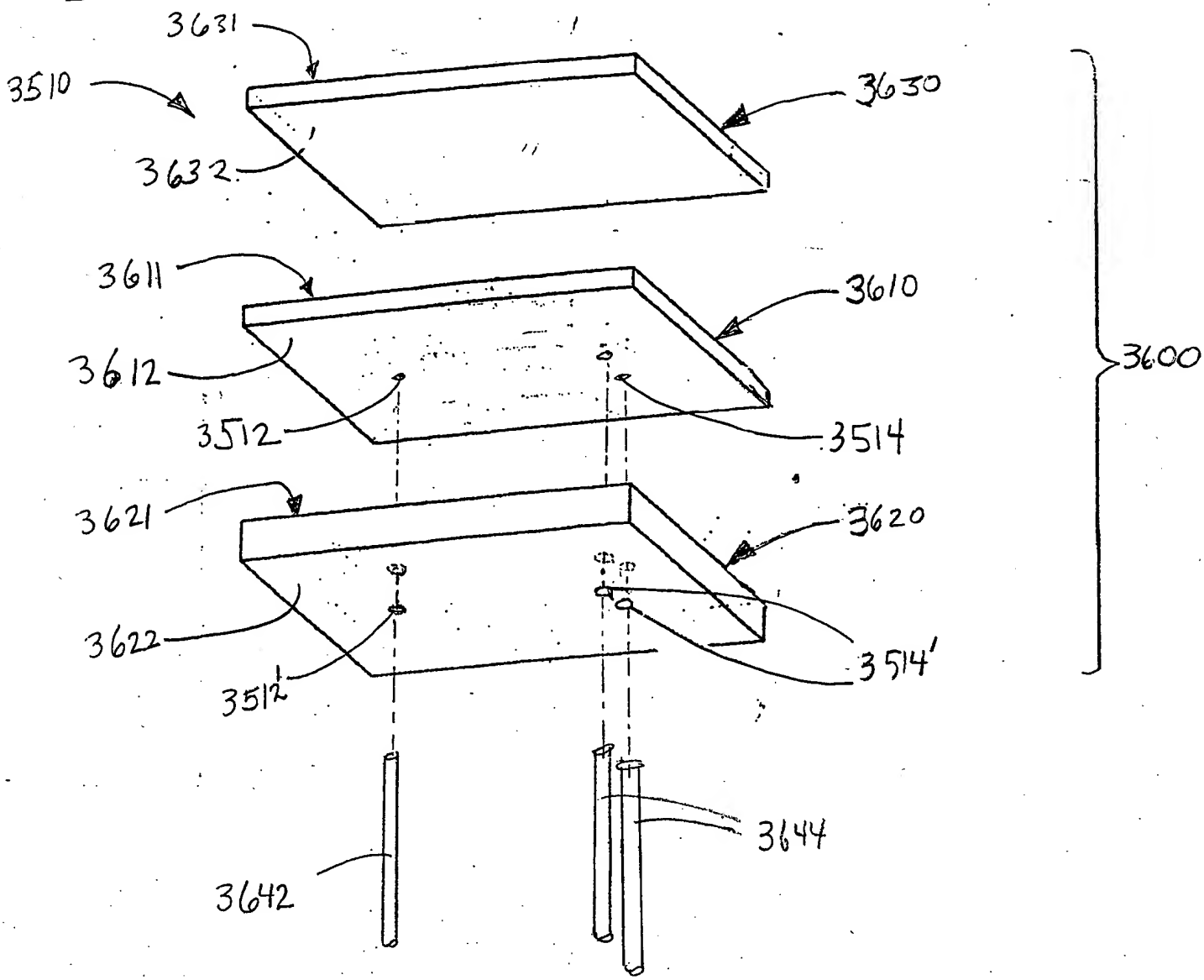

3631
3510
3630
3632
3611
3610
3612
3600
3512
3514
3621
3620
3622
3514'
3512'
3644
3642

FIG. 3F

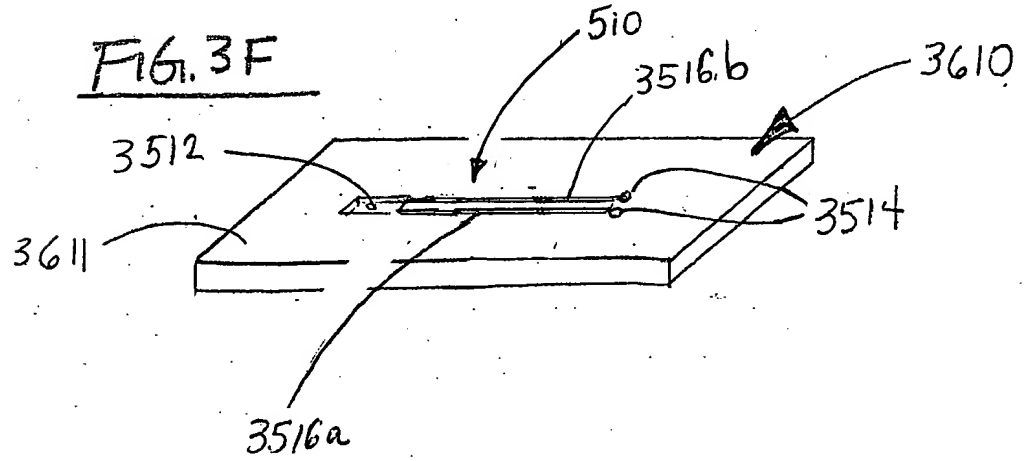

510
3516b
3610
3512
3514
3611
3516a

FIG. 3G

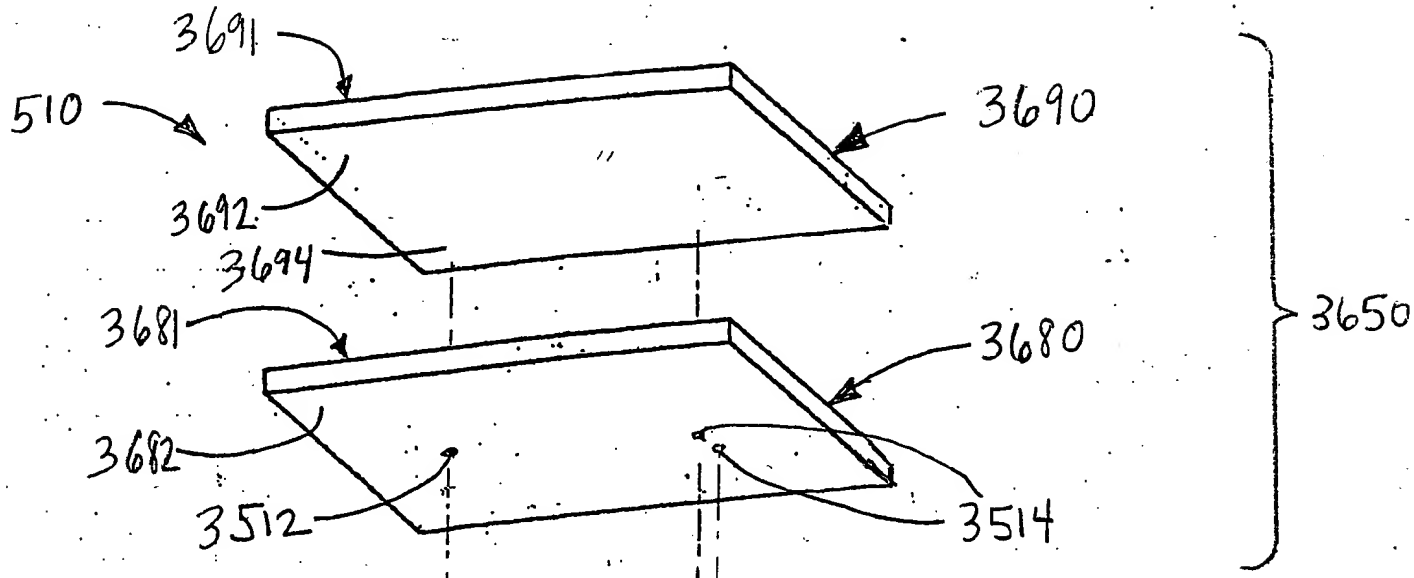


FIG. 3H

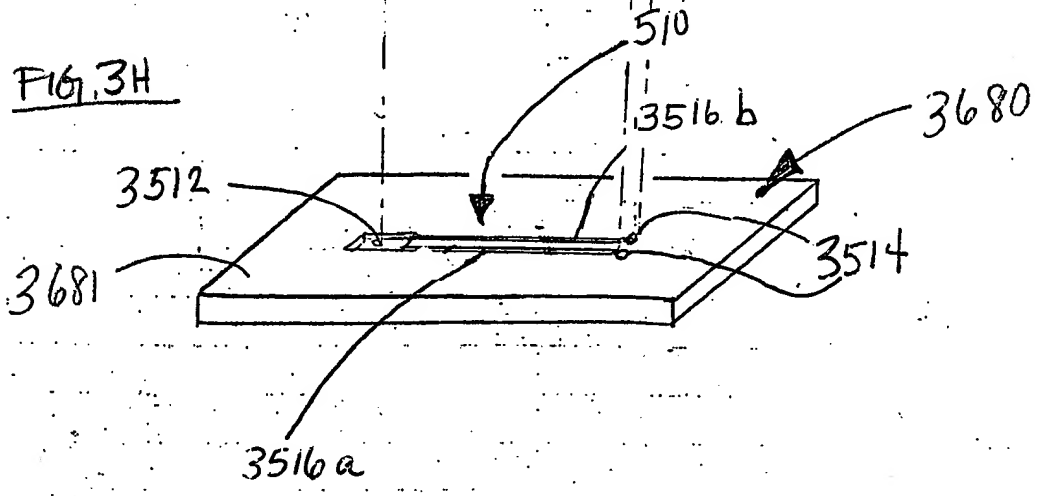


FIG. 3I

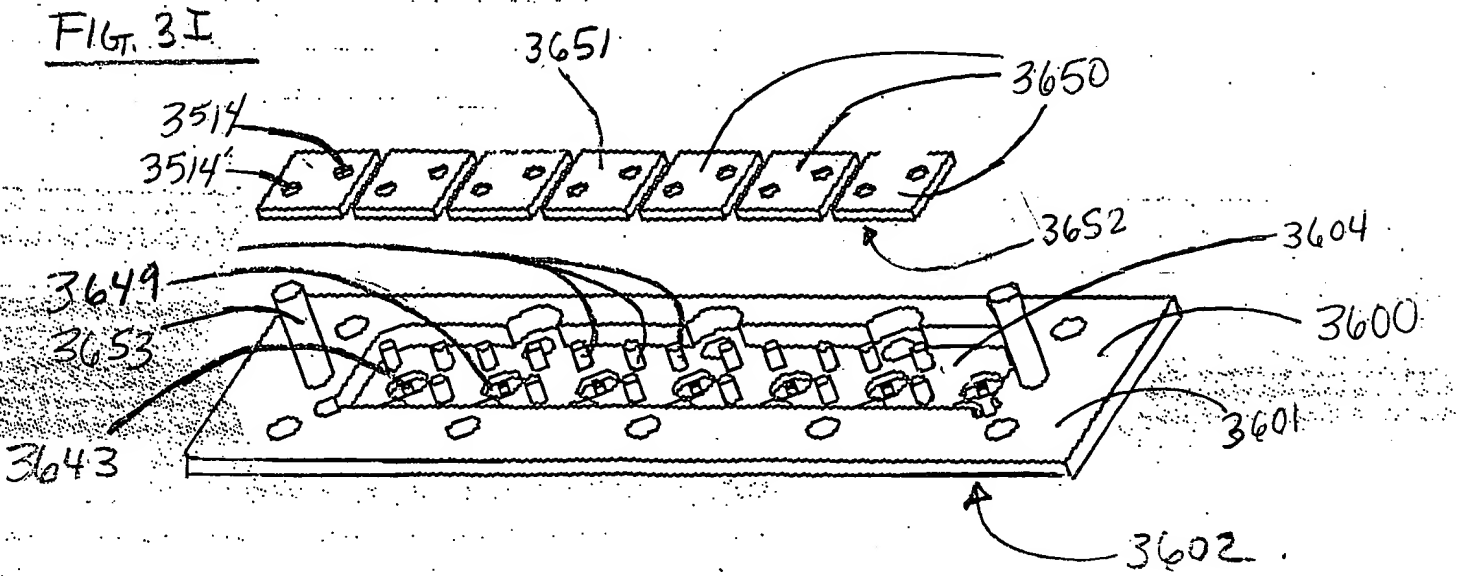


FIG. 4A

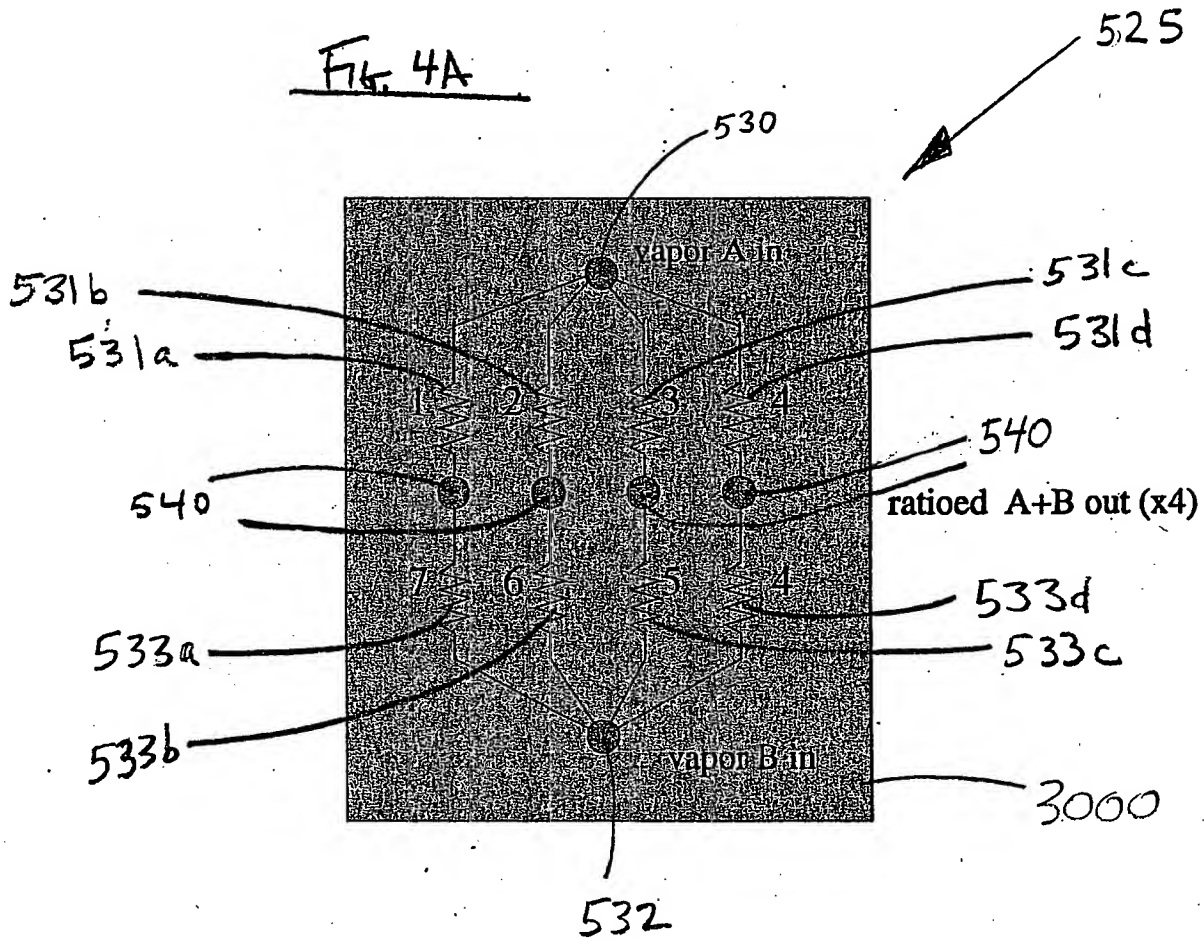

525
530
vapor A in
531b
531a
531c
531d
1
2
3
4
540
540
ratioed A+B out (x4)
7
6
5
4
533d
533a
533c
533b
vapor B in
3000
532

FIG. 4B

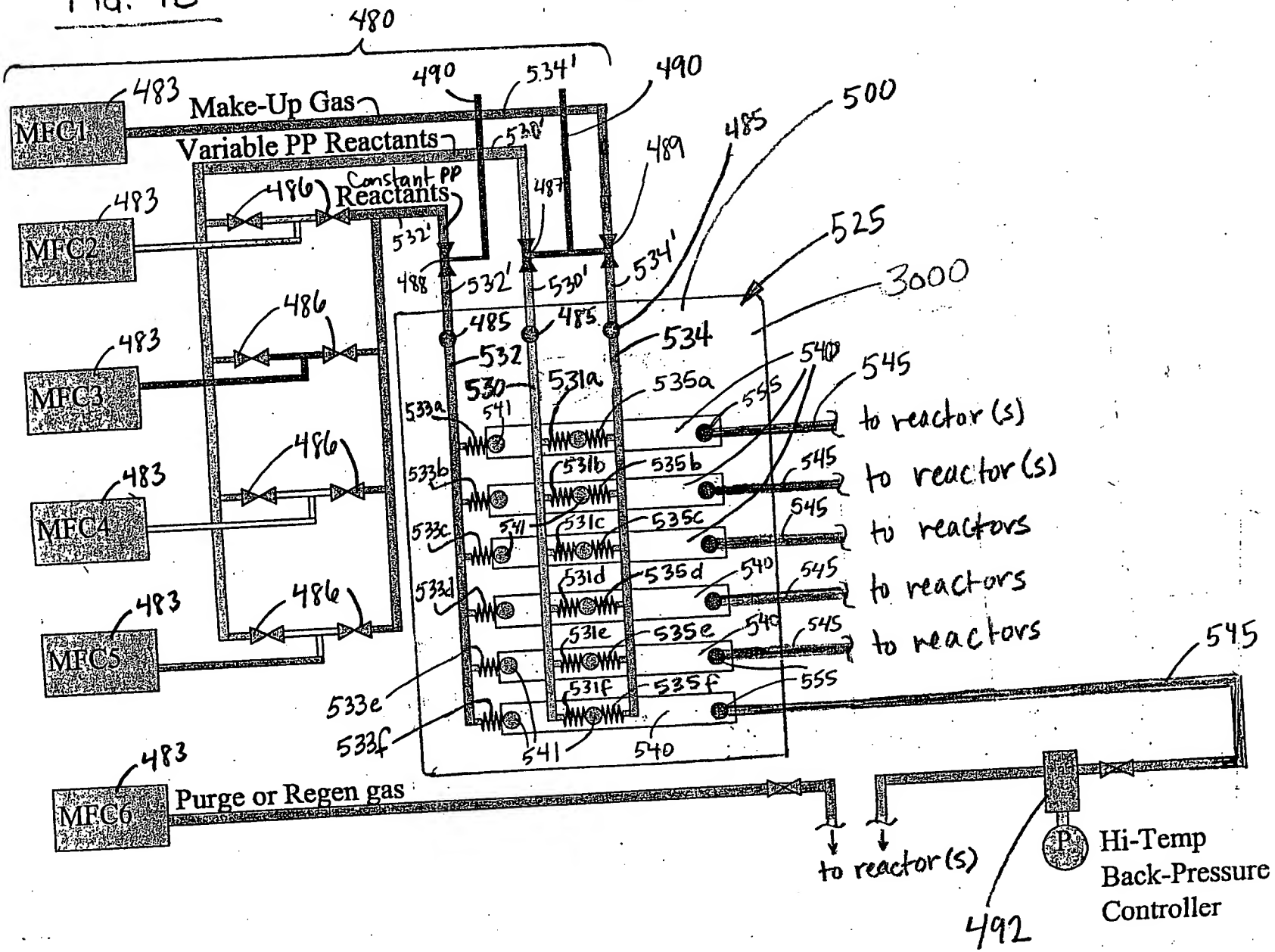

480
MFC1
MFC2
MFC3
MFC4
MFC5
MFC6
483
Make-Up Gas
Variable PP Reactants
Constant PP Reactants
Purge or Regen gas
486
487
488
489
490
485
500
525
3000
534
534'
532
532'
530
530'
531a
531b
531c
531d
531e
531f
533a
533b
533c
533d
533e
533f
535a
535b
535c
535d
535e
535f
540
541
545
555
to reactor(s)
to reactors
492
P
Hi-Temp Back-Pressure Controller

FIG. 4C

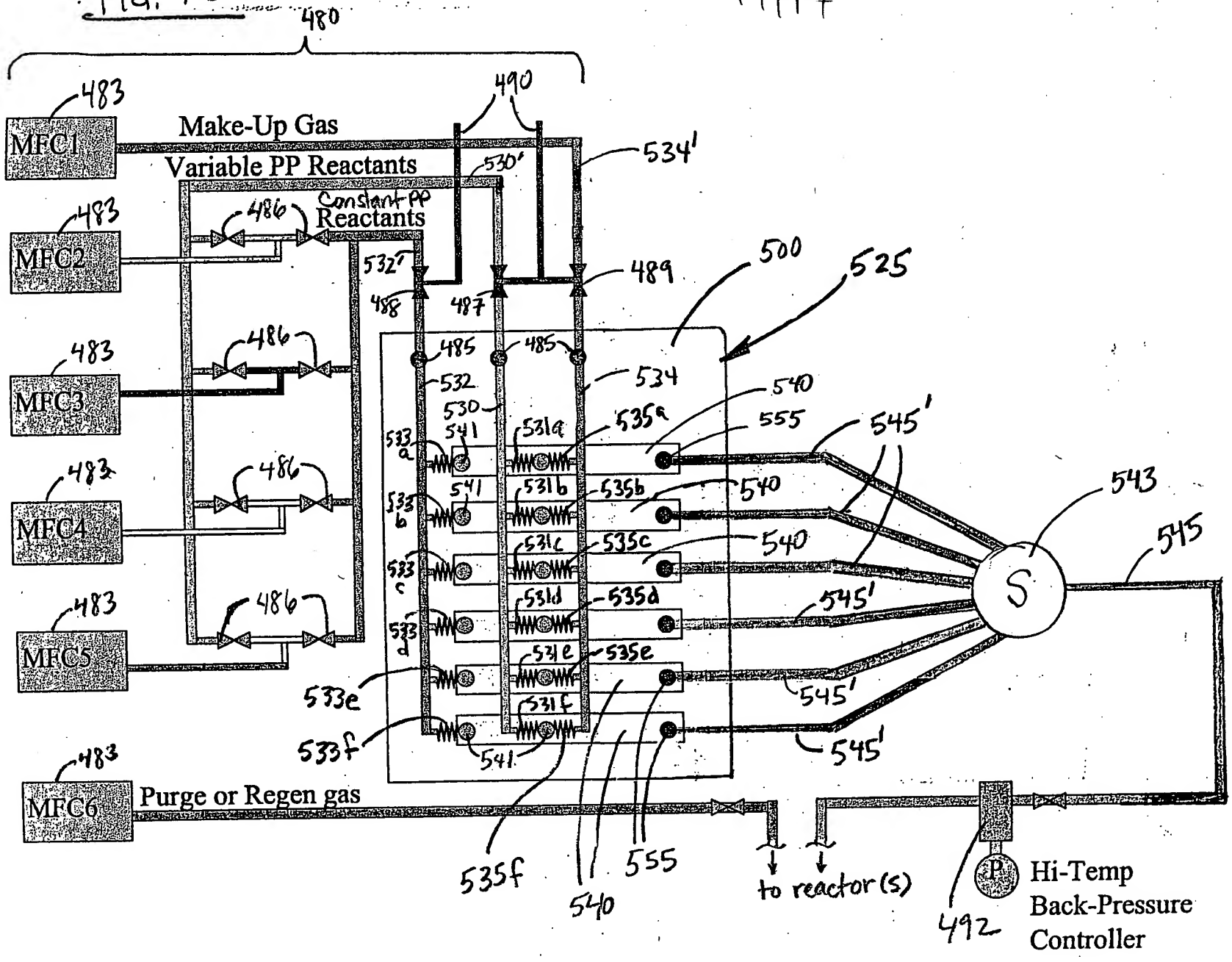

480
483
MFC1
Make-Up Gas
Variable PP Reactants
490
534'
530'
MFC2
Constant PP
Reactants
486
532'
488
487
489
500
525
MFC3
485
532
534
530
541
533a
531a
535a
540
555
545'
MFC4
533b
531b
535b
543
S
545
533c
531c
535c
MFC5
533d
531d
535d
533e
531e
535e
533f
531f
541
MFC6
Purge or Regen gas
535f
555
540
to reactor(s)
492
P
Hi-Temp
Back-Pressure
Controller

FIG. 4D

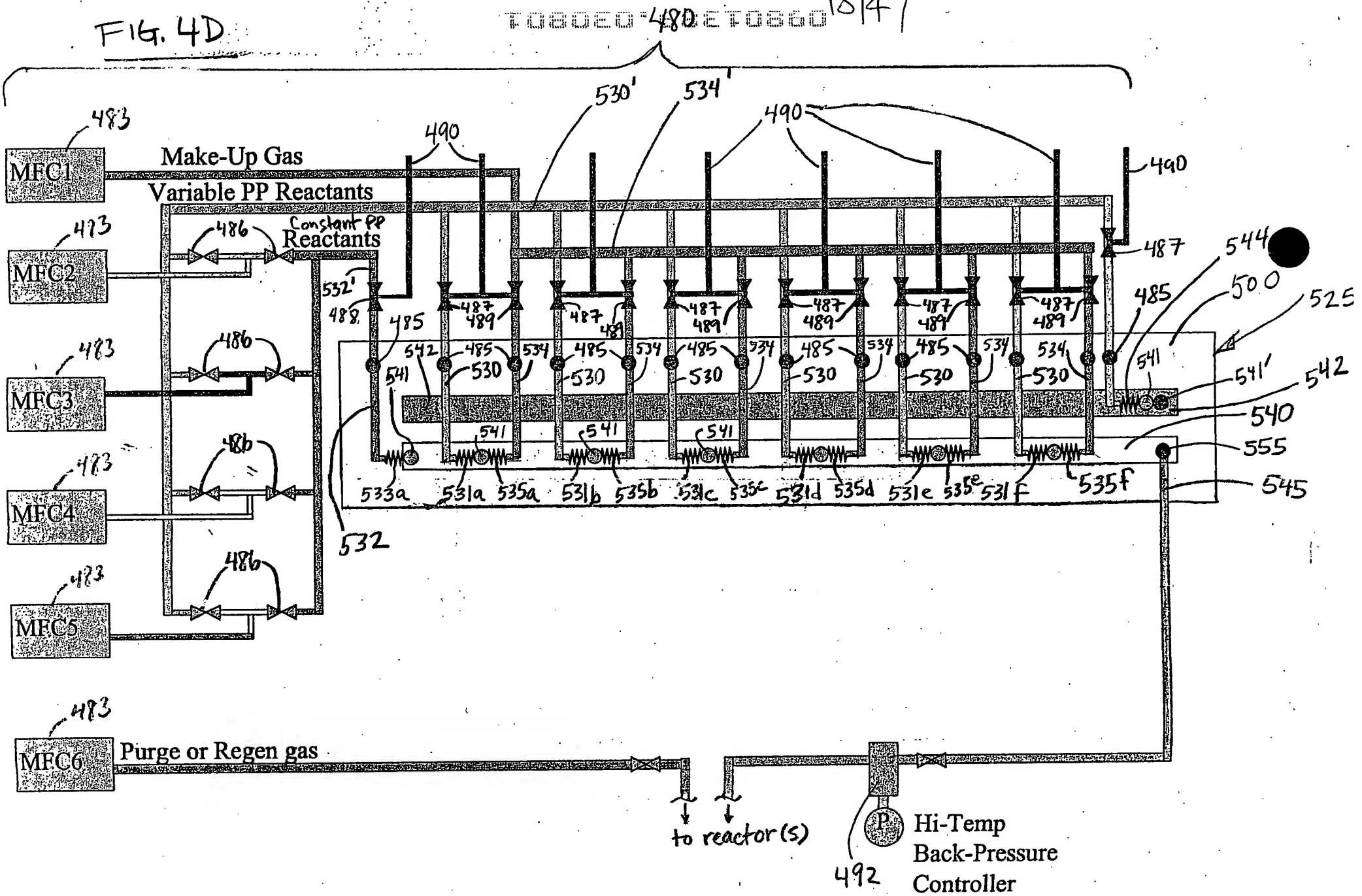

480
483
MFC1
Make-Up Gas
Variable PP Reactants
MFC2
Constant PP Reactants
MFC3
MFC4
MFC5
MFC6
Purge or Regen gas
486
532
532'
488
490
530'
534'
485
487
489
541
542
530
534
533a
531a
535a
531b
535b
531c
535c
531d
535d
531e
535e
531f
535f
544
500
525
541'
540
555
545
to reactor(s)
P
Hi-Temp Back-Pressure Controller
492

FIG. 4E

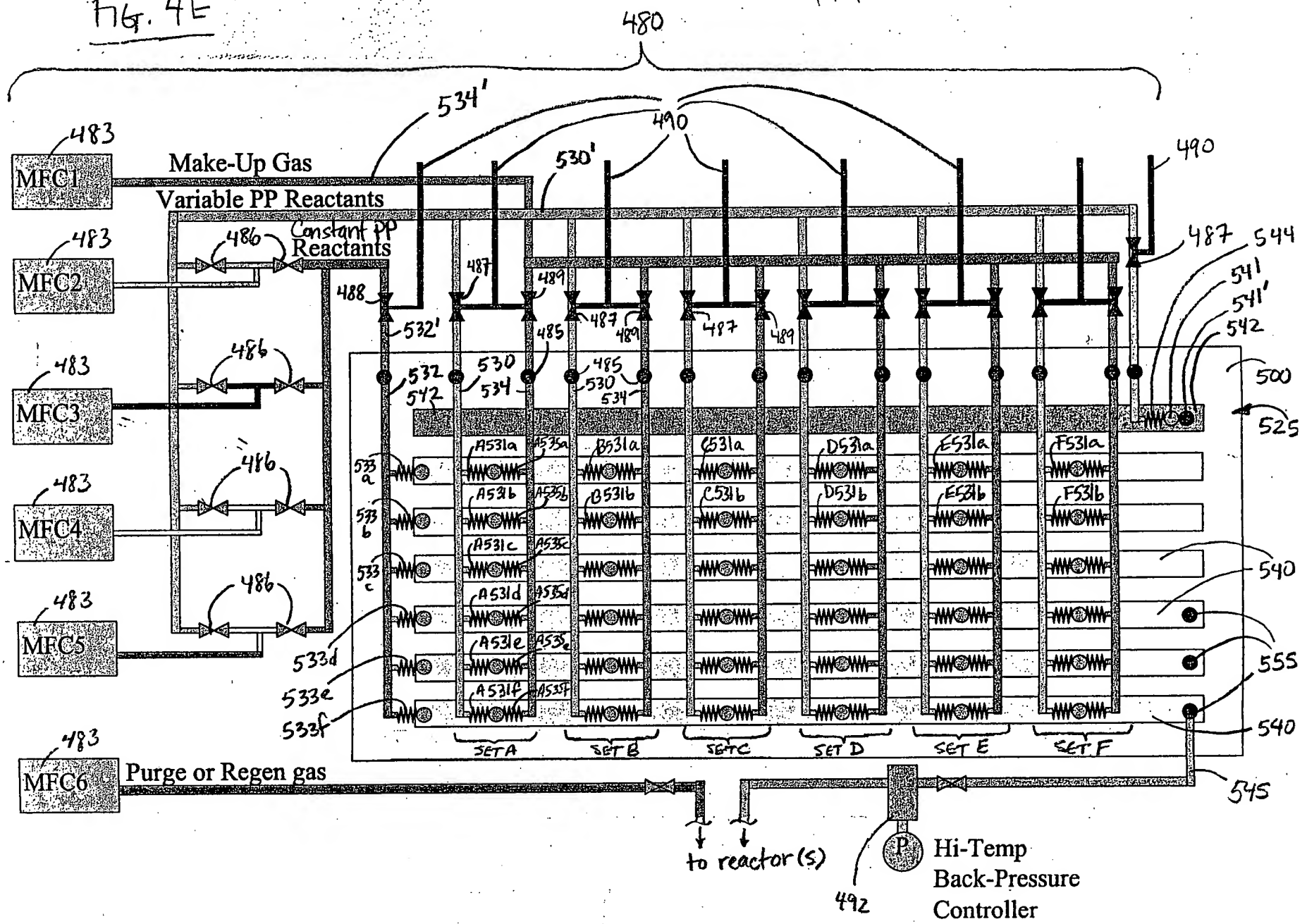

480
534'
490
530'
490
483
MFC1
Make-Up Gas
Variable PP Reactants
Constant PP Reactants
MFC2
MFC3
MFC4
MFC5
MFC6
Purge or Regen gas
486
488
487
489
485
532'
532
542
530
534
487
544
541
541'
542
500
525
A531a
A535a
B531a
C531a
D531a
E531a
F531a
A531b
A535b
B531b
C531b
D531b
E531b
F531b
A531c
A535c
A531d
A535d
A531e
A535e
A531f
A535f
533a
533b
533c
533d
533e
533f
SET A
SET B
SET C
SET D
SET E
SET F
540
555
545
to reactor(s)
P
492
Hi-Temp
Back-Pressure
Controller

FIG. 4F

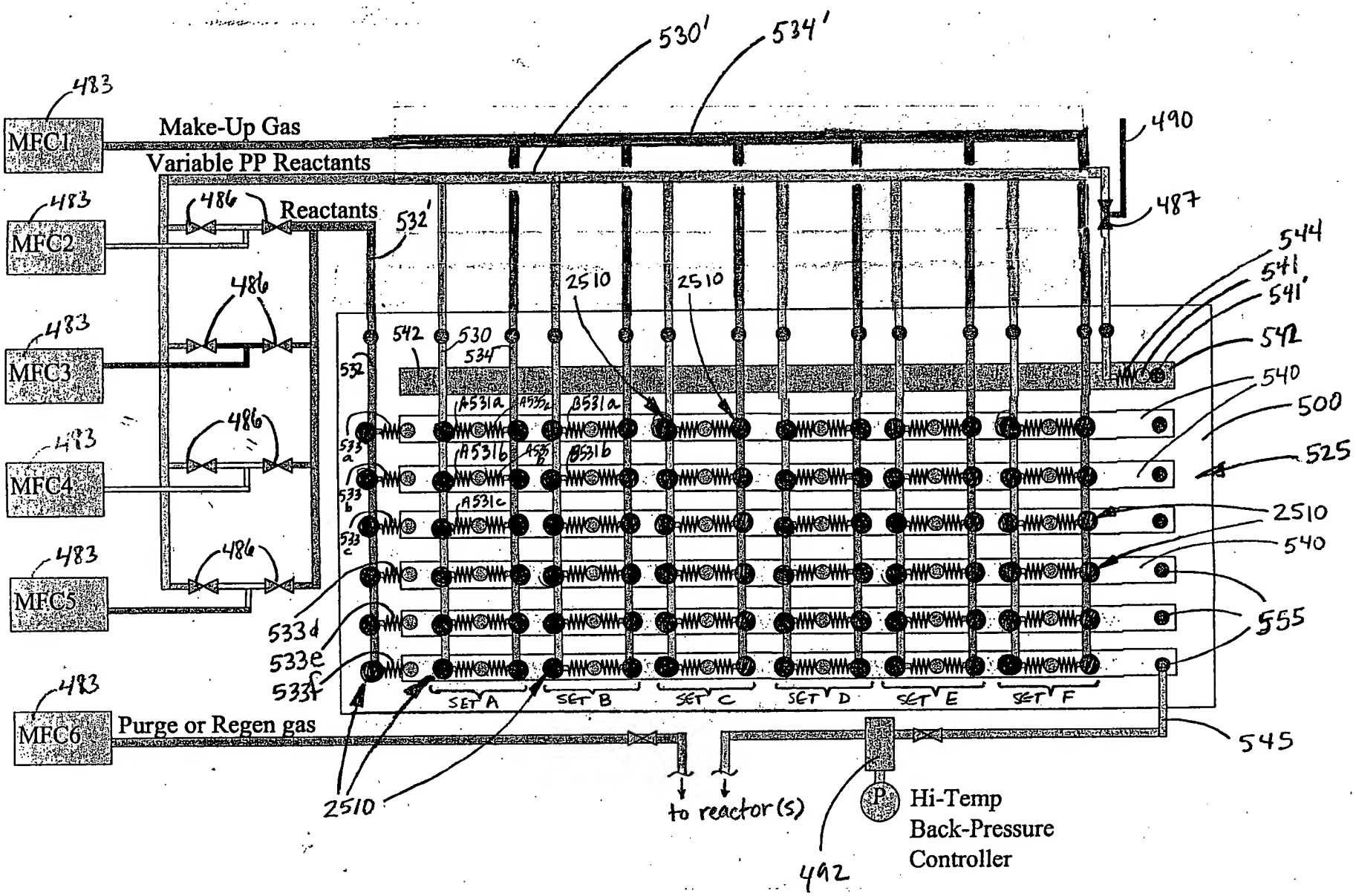

530'
534'
483
MFC1
Make-Up Gas
Variable PP Reactants
490
487
MFC2
486
Reactants
532'
544
541
541'
542
MFC3
2510
2510
542
530
534
532
540
500
A531a
A531b
B531a
533a
A531b
B531b
525
533b
A531c
2510
533c
540
533d
555
533e
533f
SET A
SET B
SET C
SET D
SET E
SET F
MFC4
MFC5
MFC6
Purge or Regen gas
545
2510
to reactor(s)
P
Hi-Temp
Back-Pressure
Controller
492

FIG. 5A

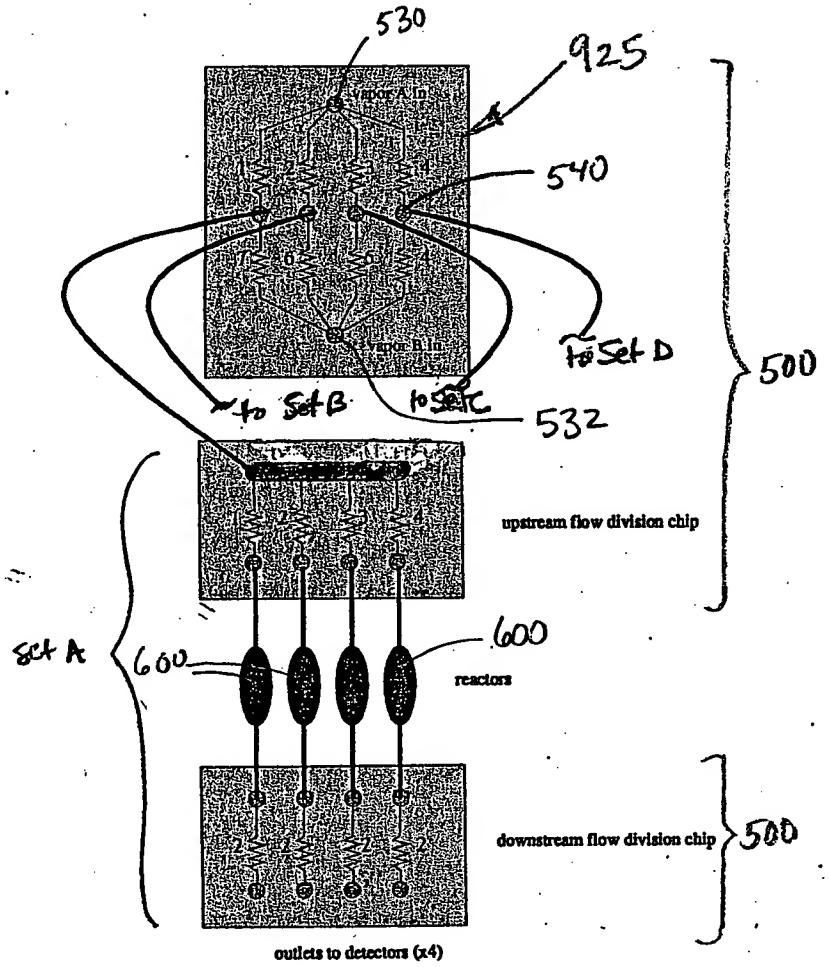

530
925
540
Vapor A In
Vapor B In
to Set D
to Set B
to Set C
532
500
upstream flow division chip
Set A
600
600
reactors
downstream flow division chip
500
outlets to detectors (x4)

FIG. 5B

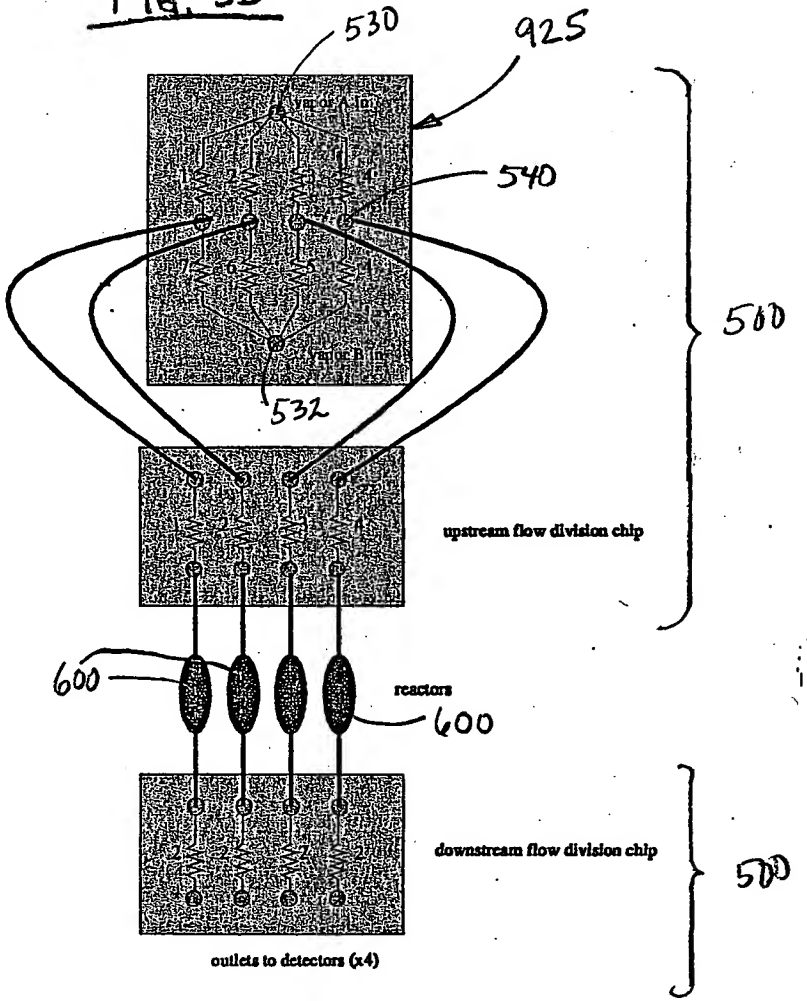

530
925
540
Vapor A In
Vapor B In
532
500
upstream flow division chip
600
600
reactors
downstream flow division chip
500
outlets to detectors (x4)

FIG. 5C

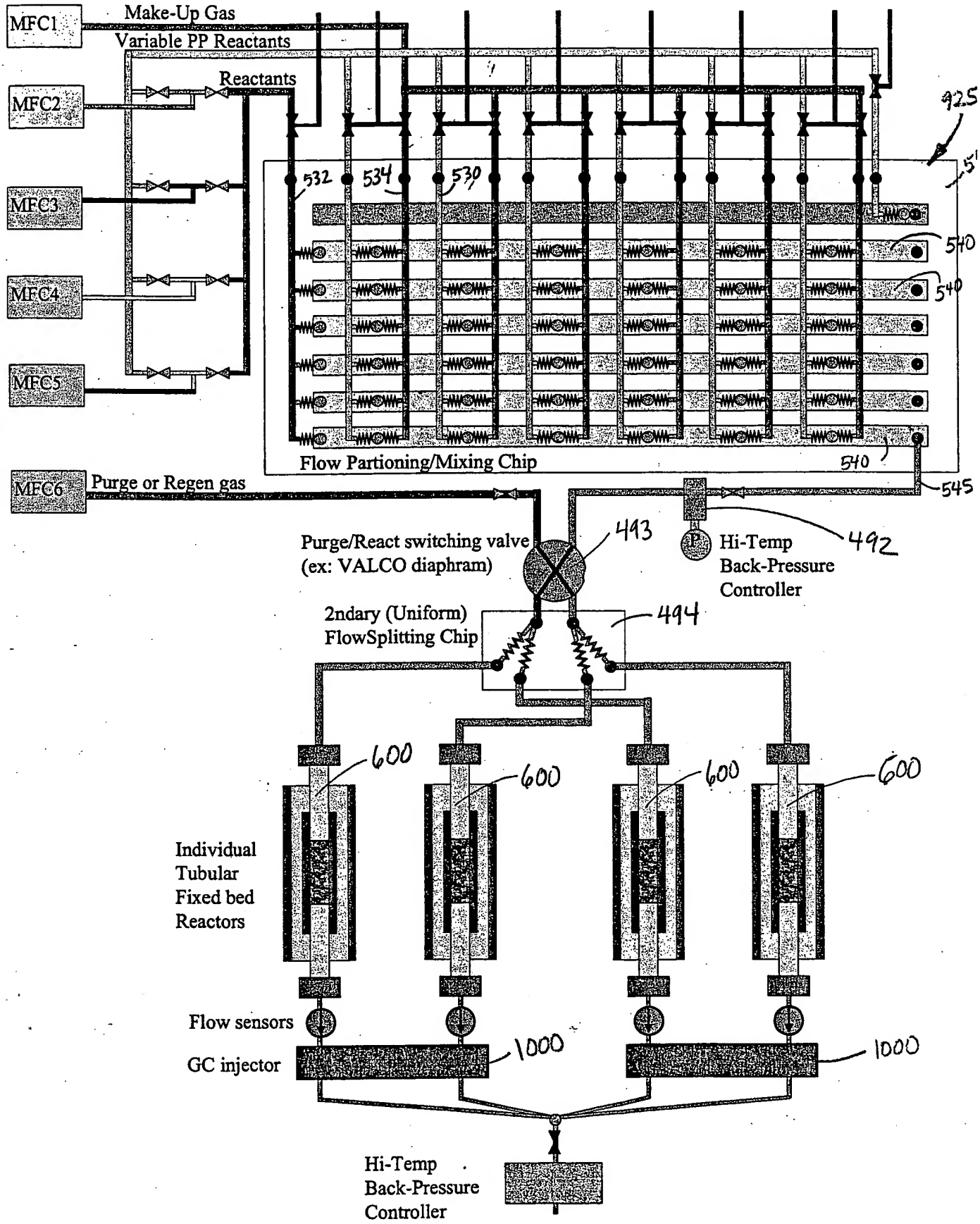

MFC1
Make-Up Gas
Variable PP Reactants
Reactants
MFC2
MFC3
MFC4
MFC5
MFC6
Purge or Regen gas
925
532
534
530
540
540
540
545
Flow Partioning/Mixing Chip
Purge/React switching valve
(ex: VALCO diaphram)
493
P
Hi-Temp
Back-Pressure
Controller
492
2ndary (Uniform)
FlowSplitting Chip
494
600
600
600
600
Individual
Tubular
Fixed bed
Reactors
Flow sensors
GC injector
1000
1000
Hi-Temp
Back-Pressure
Controller

FIG. 6A

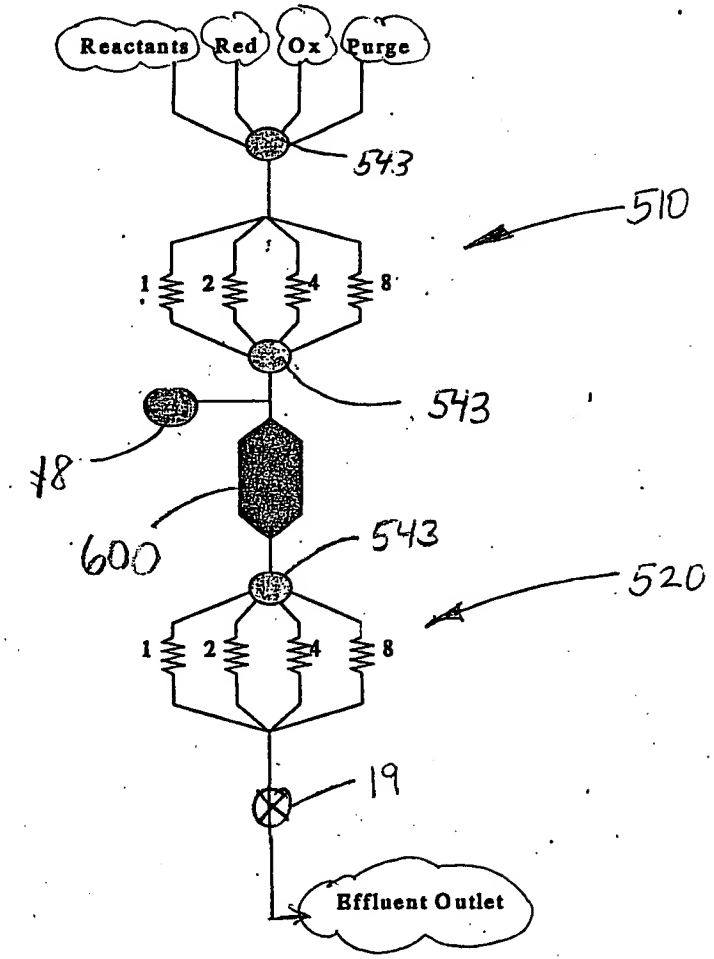

Reactants
Red
Ox
Purge
543
510
1
2
4
8
543
18
600
543
520
1
2
4
8
19
Effluent Outlet

FIG. 7A

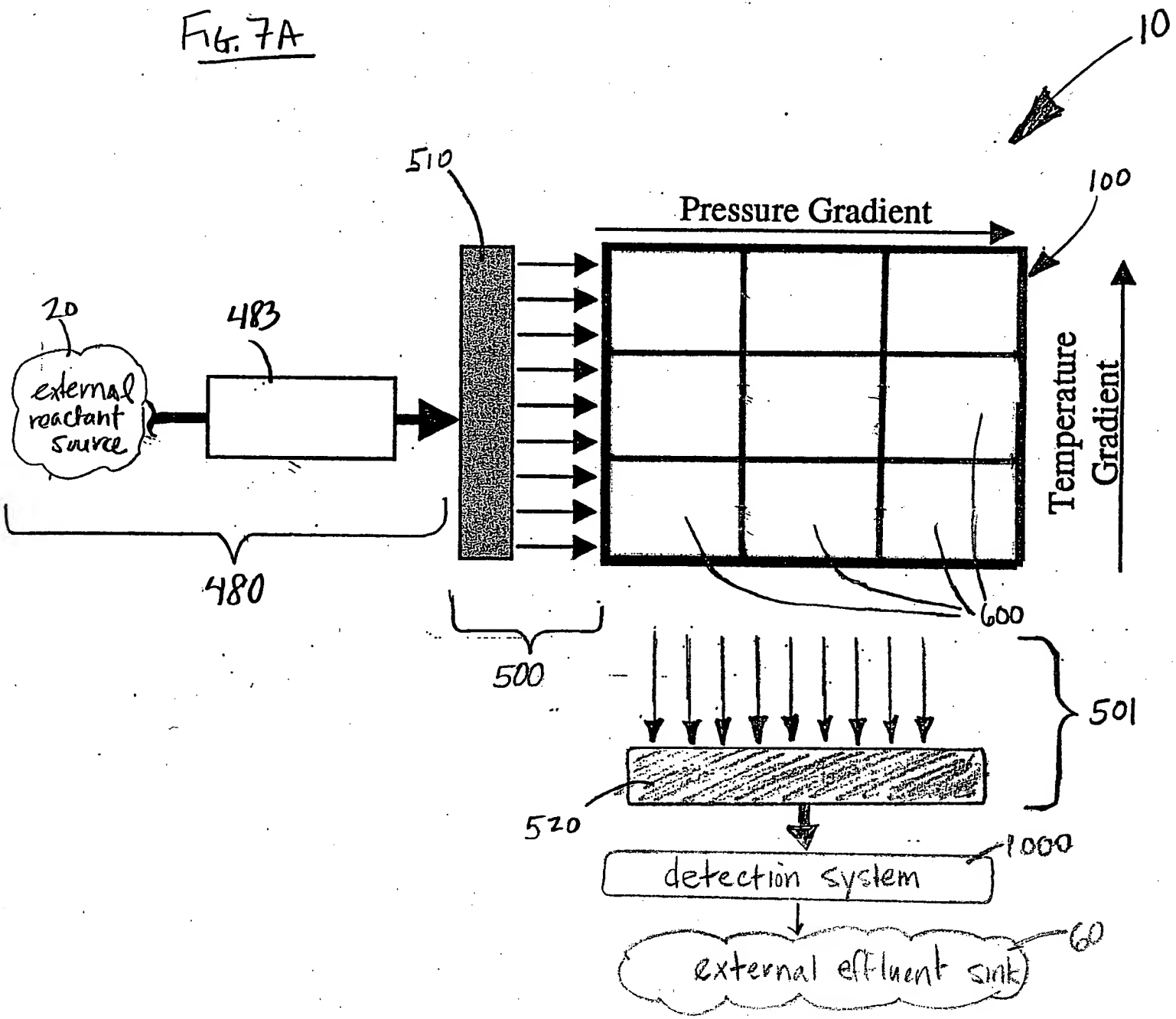

10
510
100
Pressure Gradient
20
483
external reactant source
Temperature Gradient
480
600
500
501
520
1000
detection system
60
external effluent sink

Fig. 7B

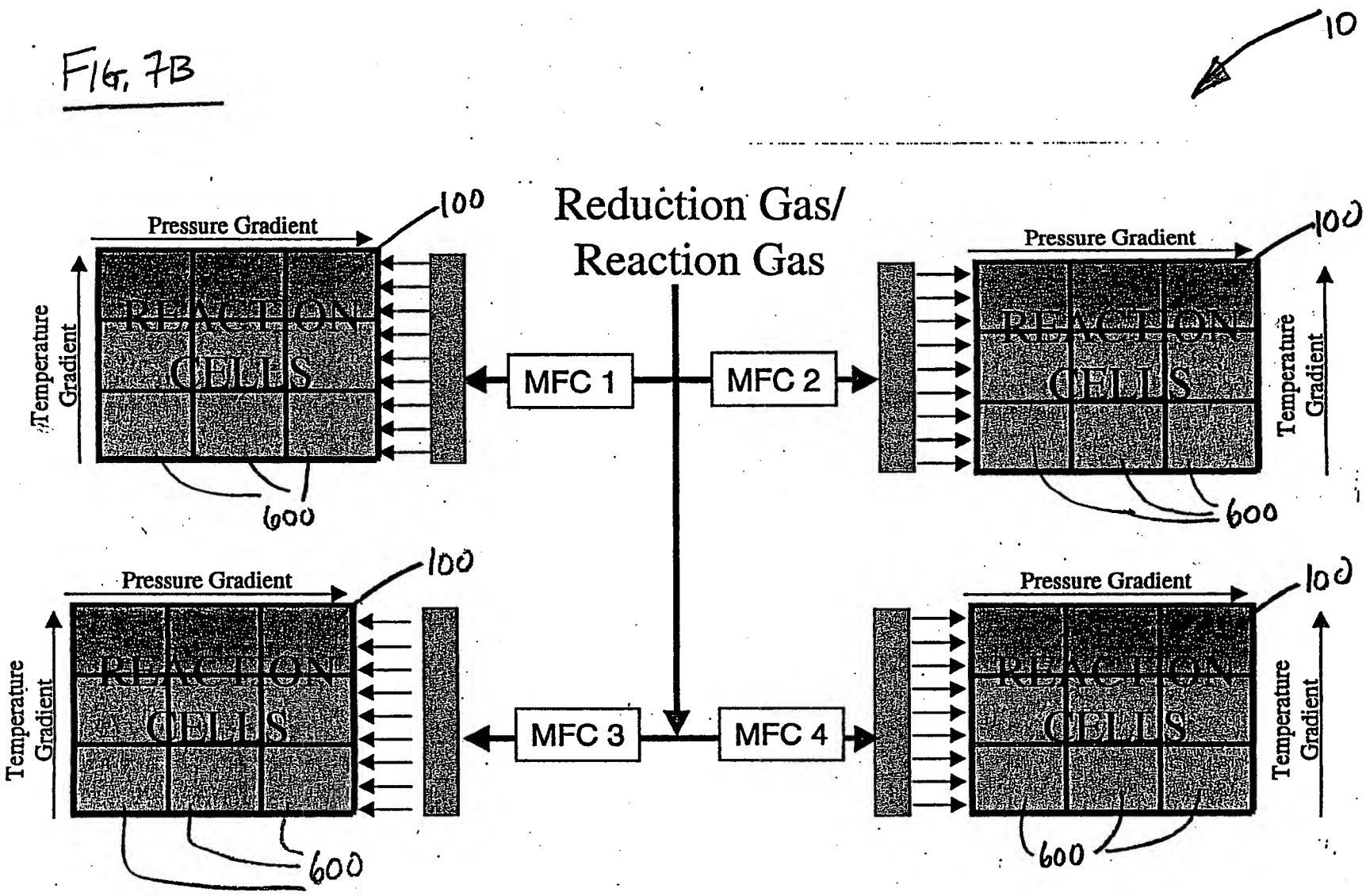

10
Reduction Gas/
Reaction Gas
MFC 1
MFC 2
MFC 3
MFC 4
Pressure Gradient
Temperature Gradient
REACTION CELLS
100
600

FIG. 7C

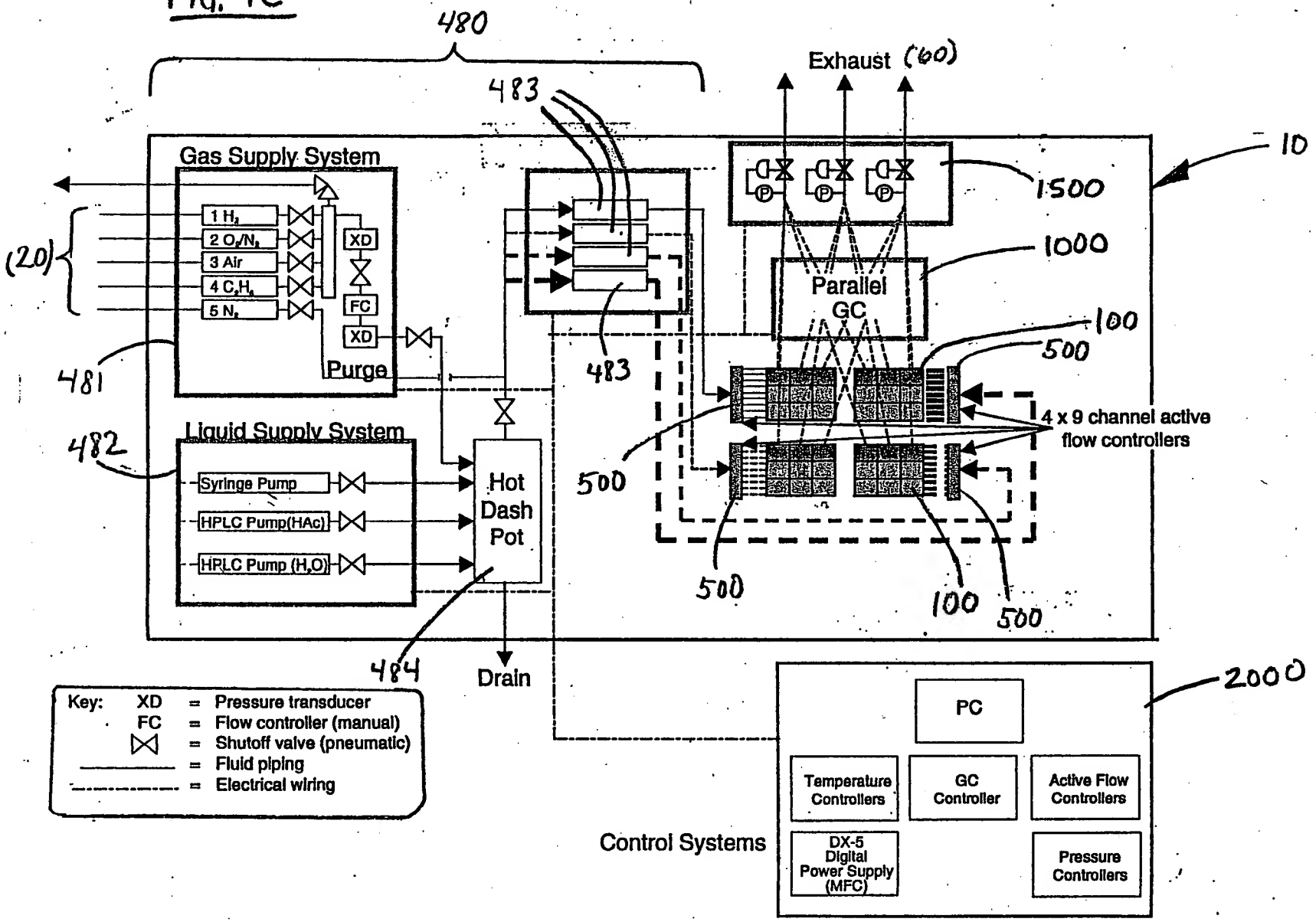

480
Exhaust (60)
483
Gas Supply System
1 H_2
2 O_2/N_2
3 Air
4 C_2H_4
5 N_2
XD
FC
XD
Purge
(20)
481
483
1500
10
1000
Parallel GC
100
500
4 x 9 channel active flow controllers
Liquid Supply System
482
Syringe Pump
HPLC Pump(HAc)
HPLC Pump (H_2O)
Hot Dash Pot
500
500
100
500
484
Drain
2000
PC
Temperature Controllers
GC Controller
Active Flow Controllers
DX-5 Digital Power Supply (MFC)
Pressure Controllers
Control Systems
Key: XD = Pressure transducer
FC = Flow controller (manual)
= Shutoff valve (pneumatic)
= Fluid piping
= Electrical wiring

Fig. 8A

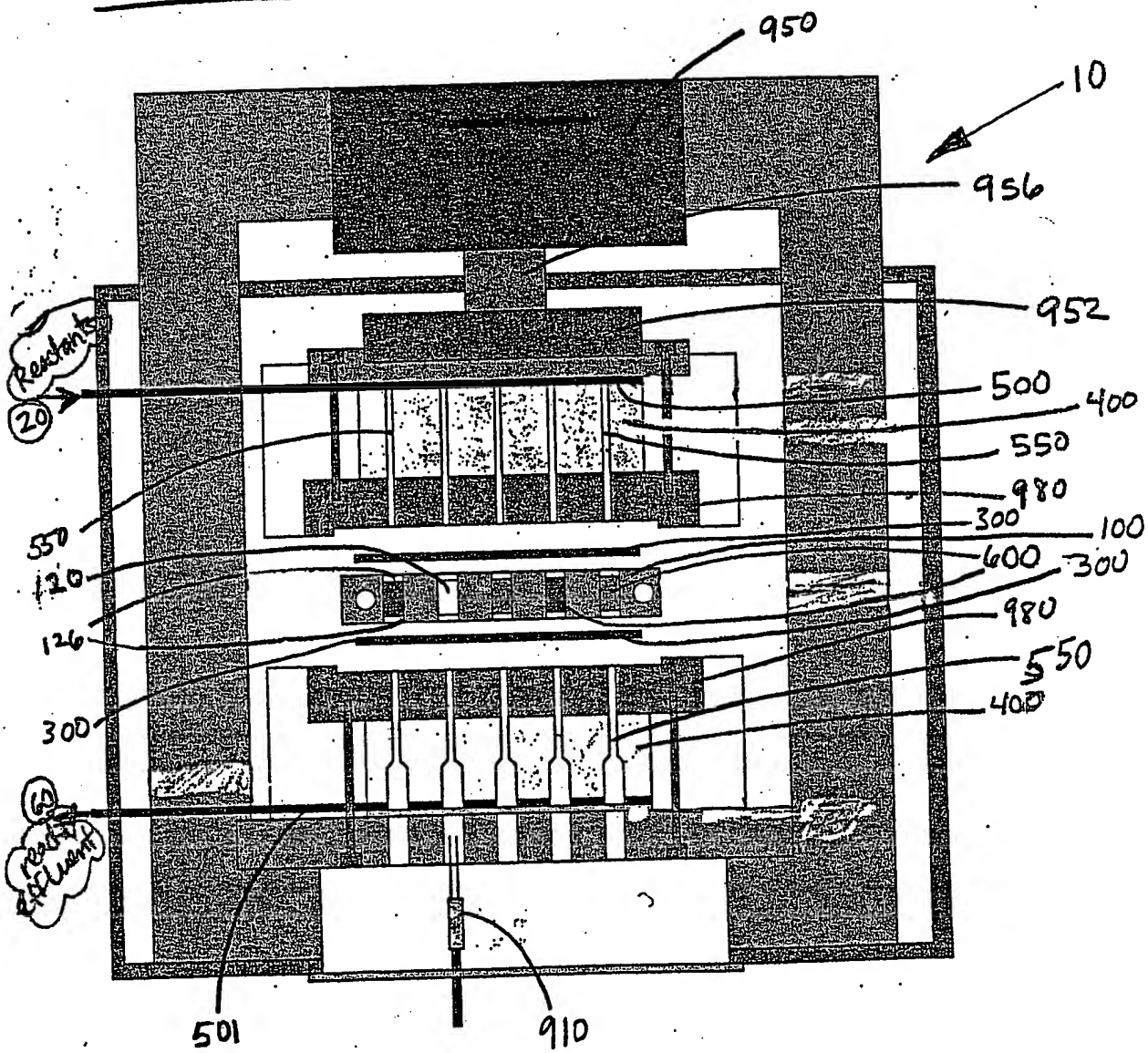

950
10
956
952
Reactants
20
500
400
550
980
550
300
100
120
600
300
126
980
550
300
40
60
reactant effluent
501
910

FIG. 8B

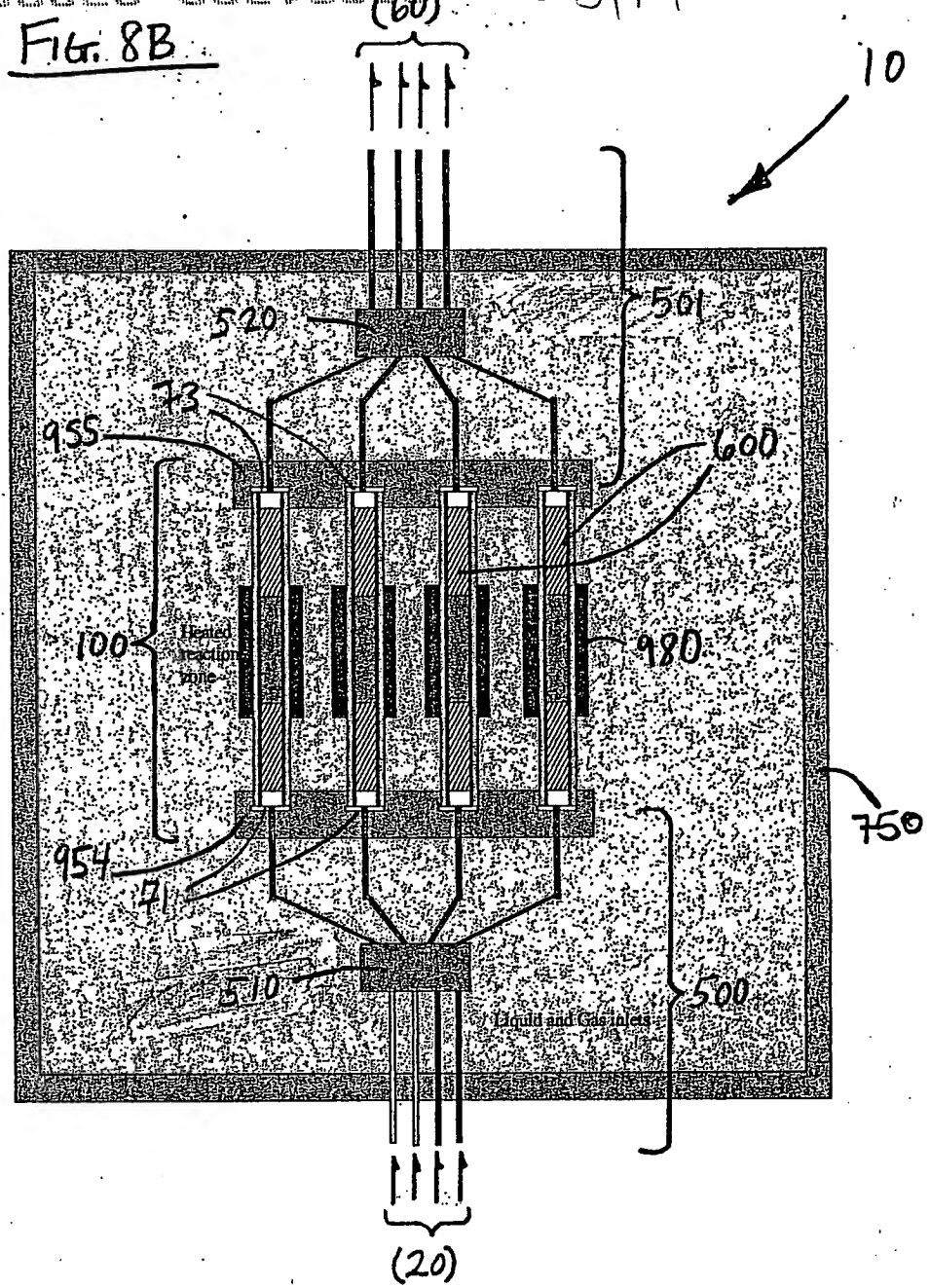

(60)
10
520
501
73
955
600
100
Heated reaction zone
980
750
954
71
510
500
Liquid and Gas inlets
(20)

FIG. 8C

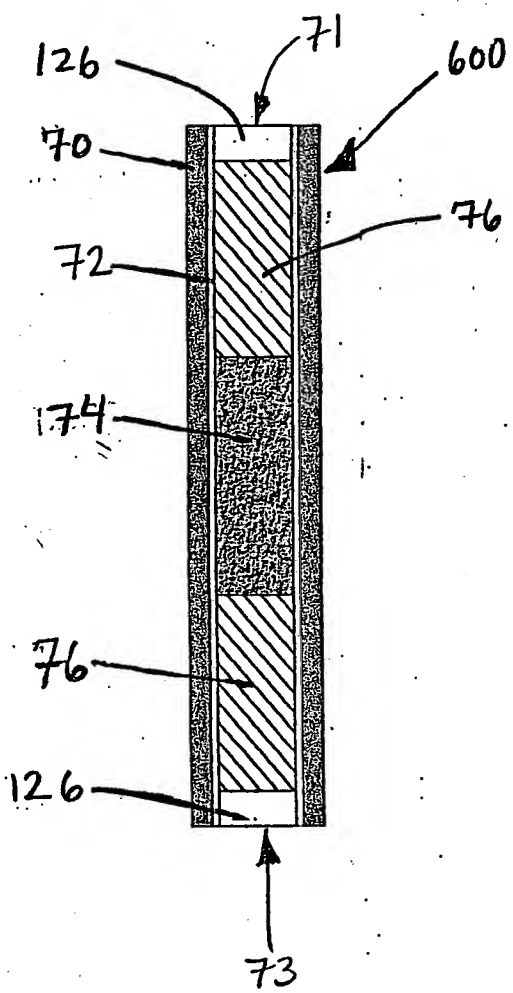


Fig. 8D

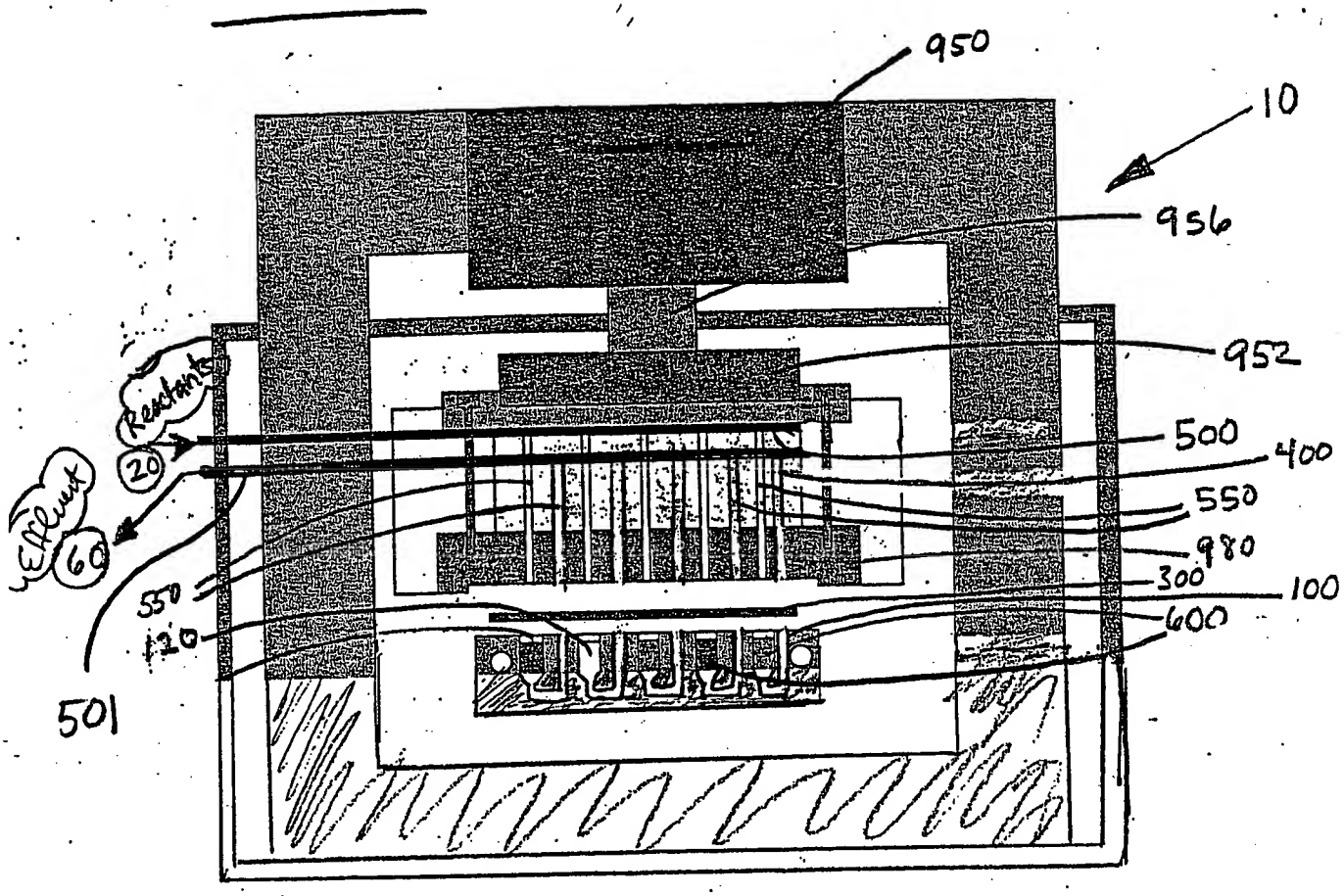

950
10
956
952
Reactants
20
500
400
550
980
300
100
600
Effluent
60
550
120
501

FIG. 8E

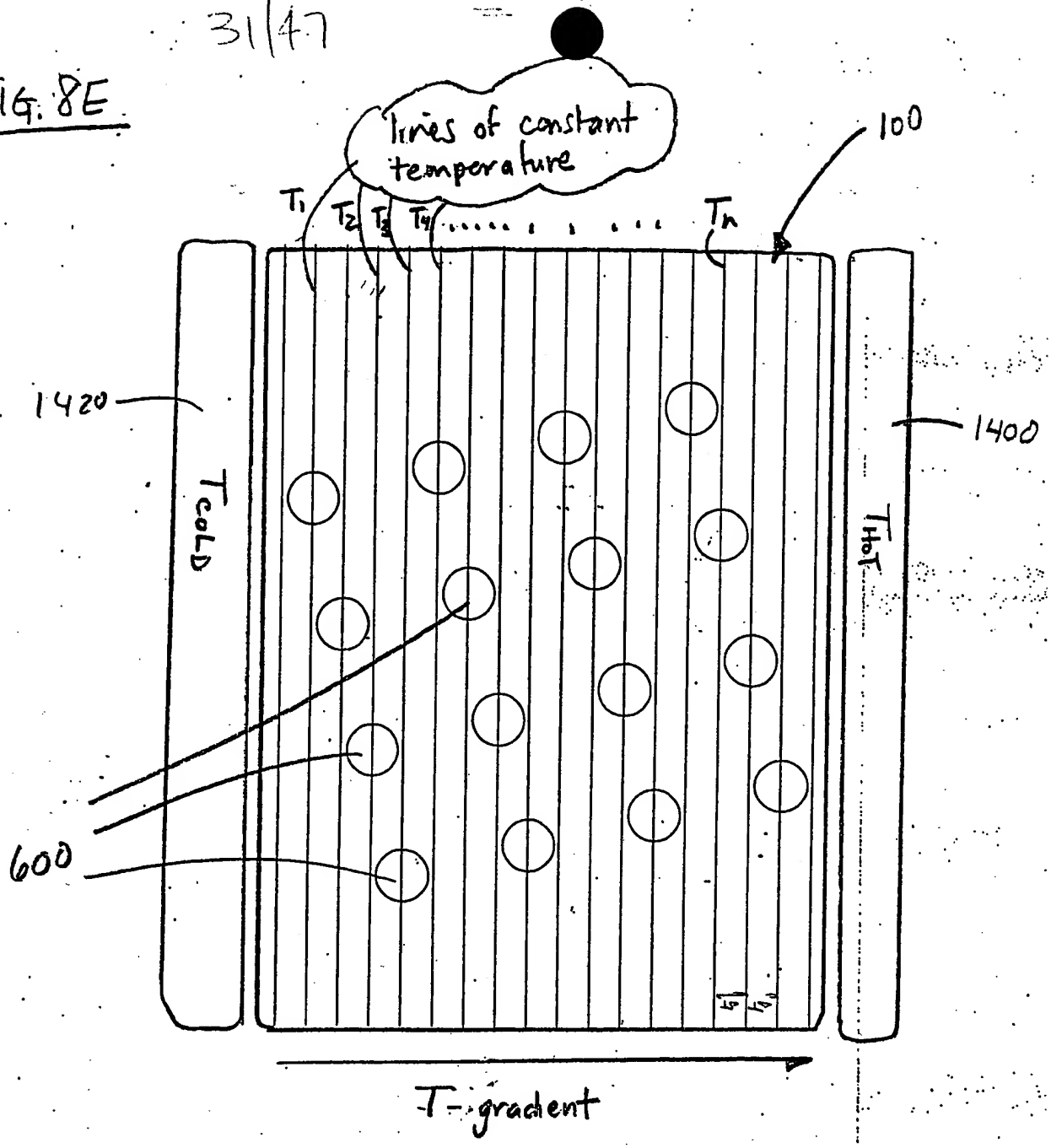

lines of constant temperature
100
T_1 T_2 T_3 T_4 ..... T_n
1420
T_{COLD}
1400
T_{HOT}
600
T-gradient

FIG. 9A

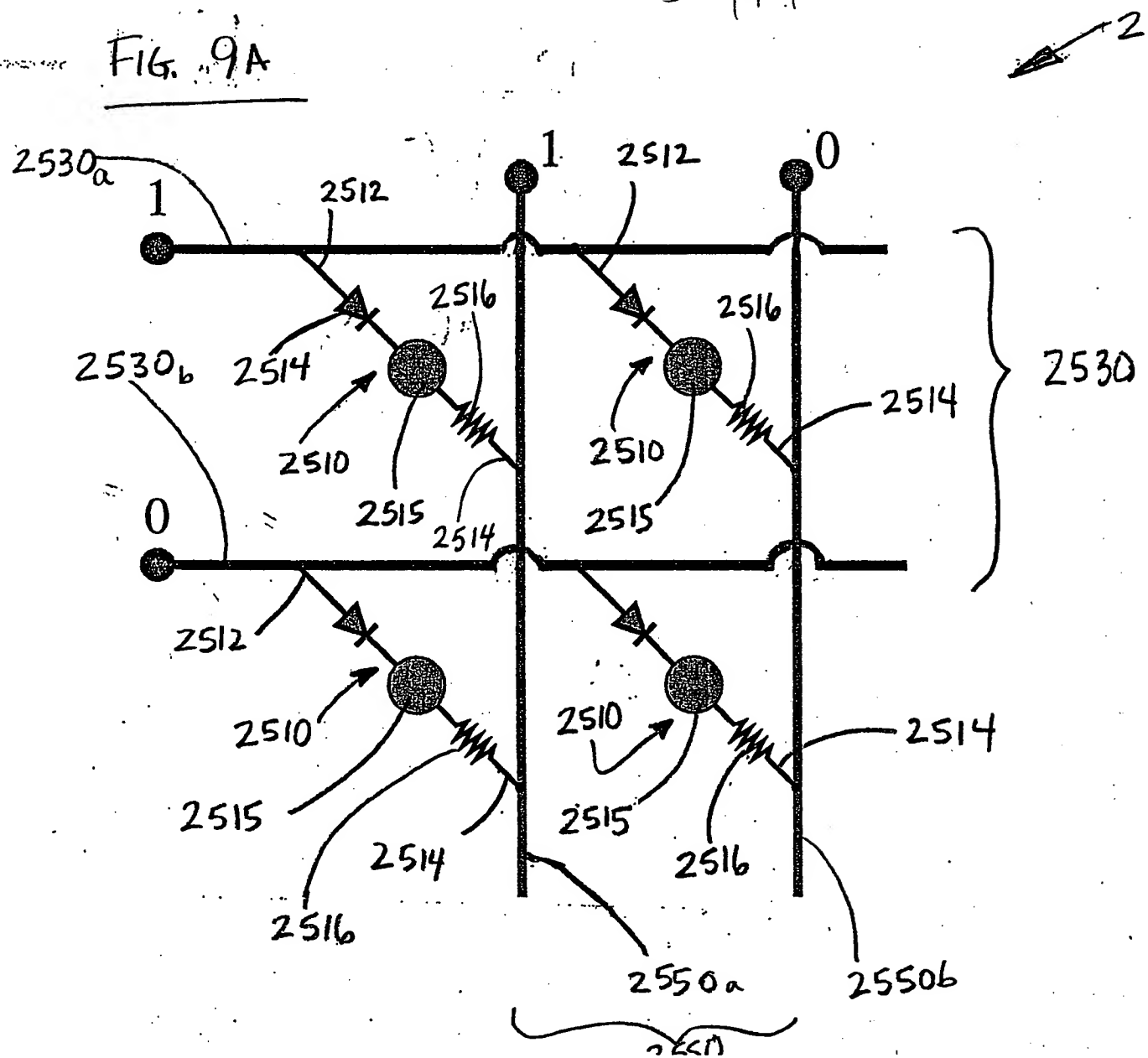

2500
2530a
1
2512
1
2512
0
2516
2516
2530b
2514
2530
2514
2510
2510
2515
2515
2514
0
2512
2510
2510
2514
2515
2515
2514
2516
2516
2550a
2550b

Fig. 9B

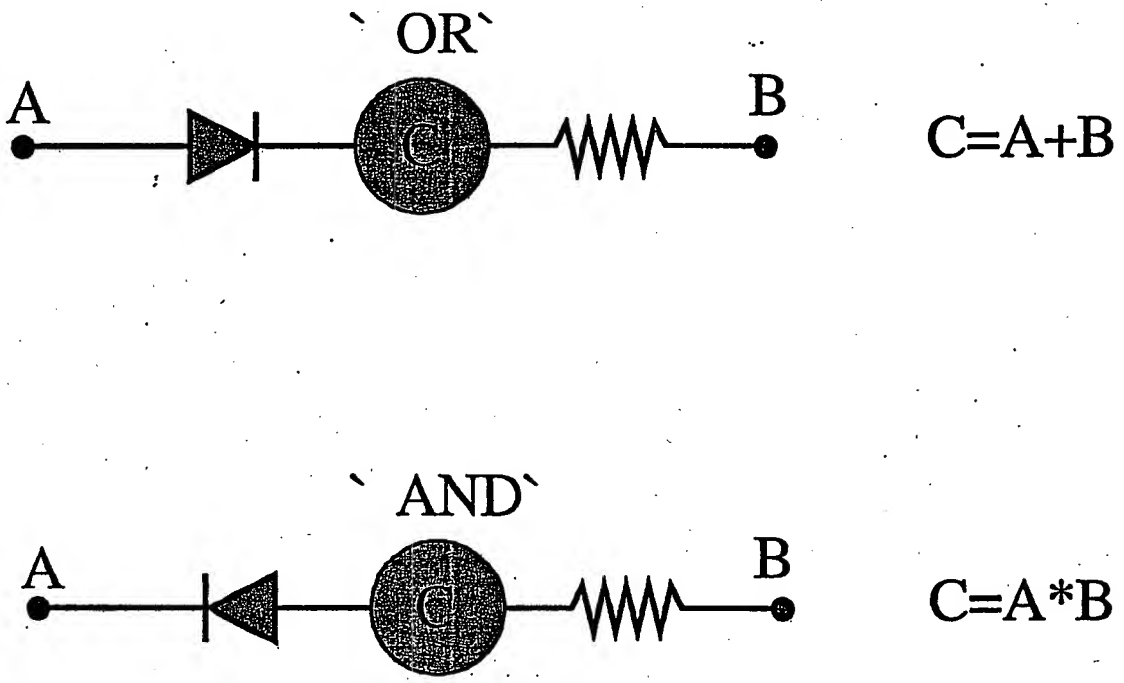


FIG. 10A

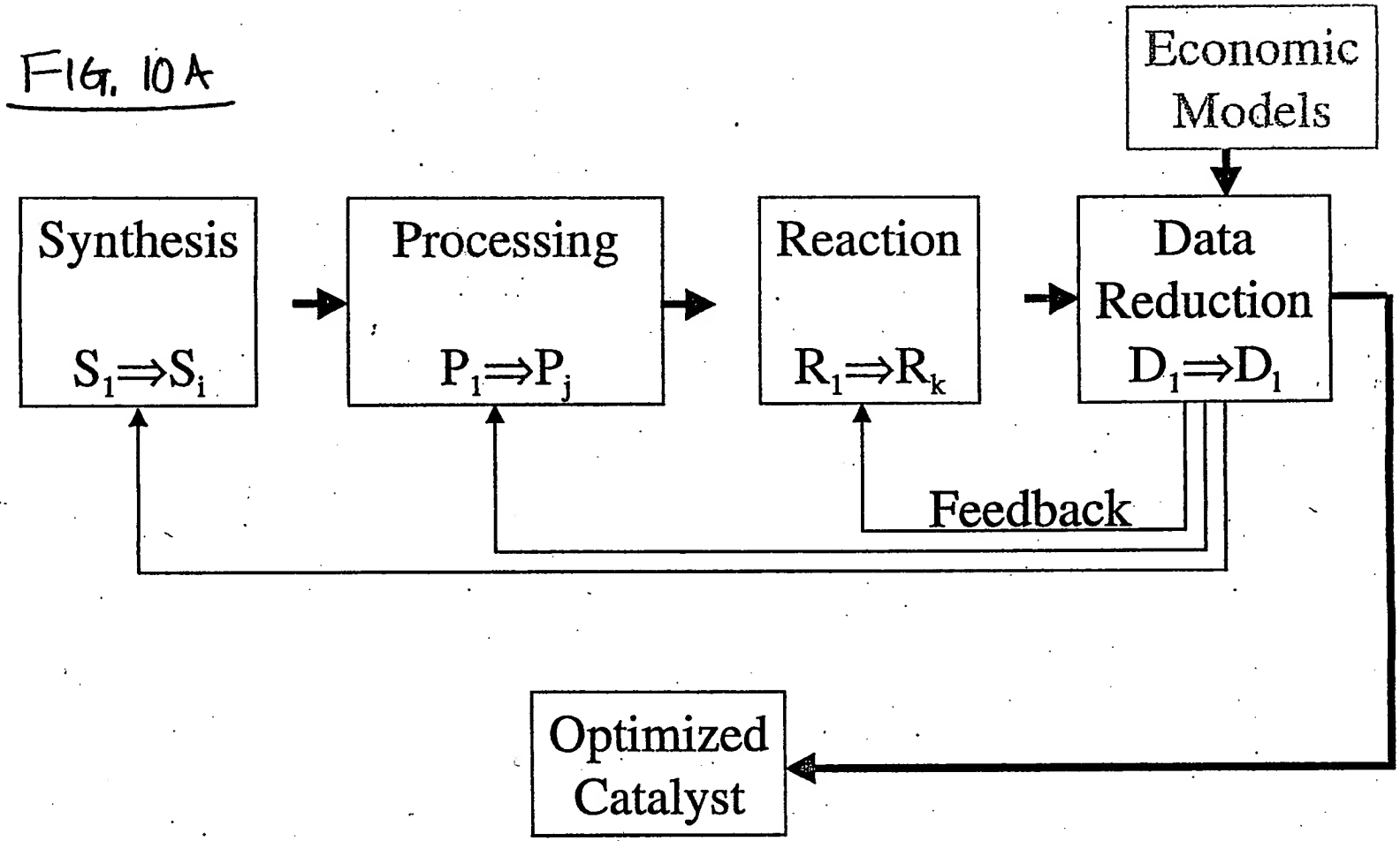
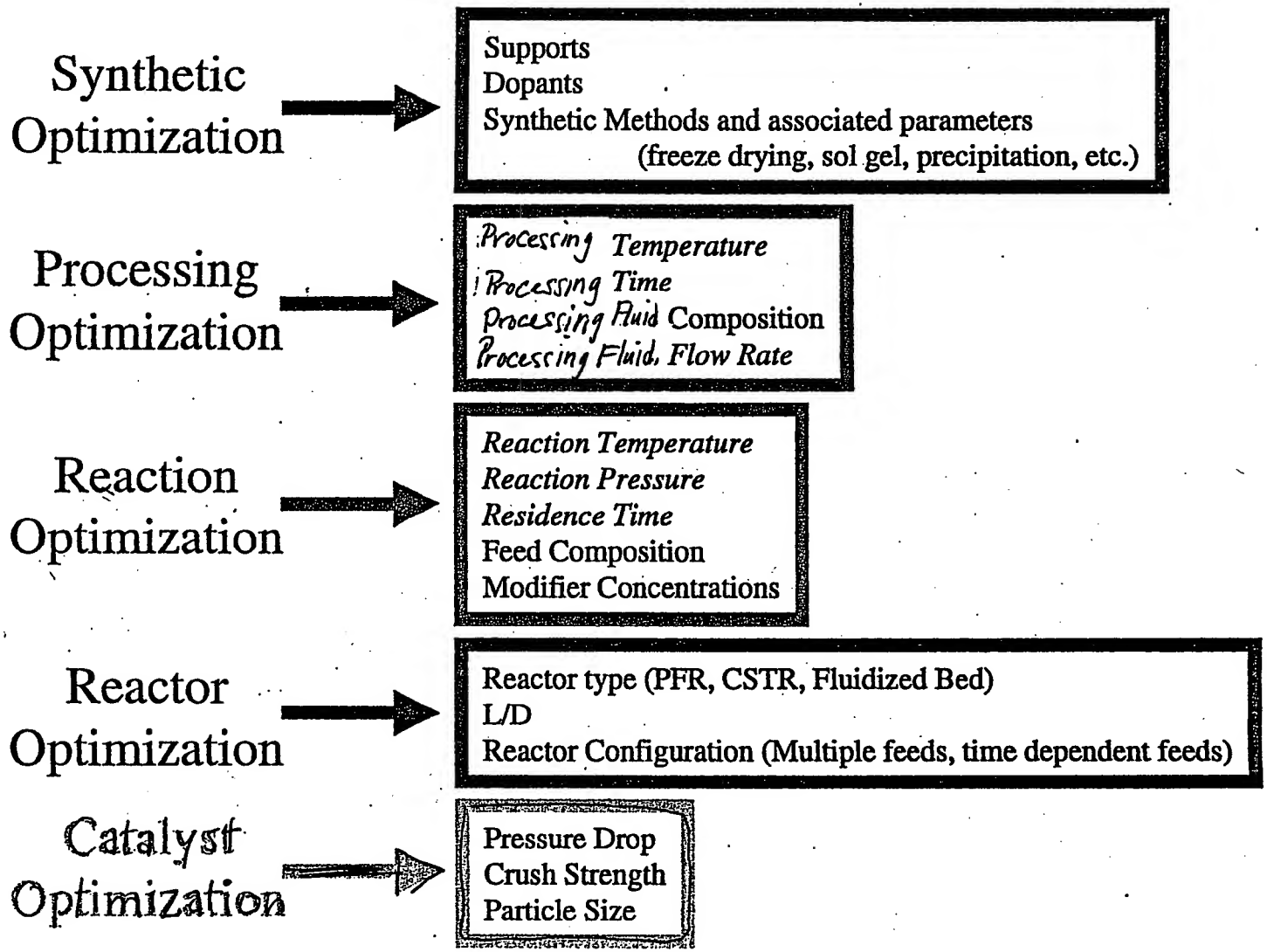

Economic Models
Synthesis
$S_1 \Rightarrow S_i$
Processing
$P_1 \Rightarrow P_j$
Reaction
$R_1 \Rightarrow R_k$
Data Reduction
$D_1 \Rightarrow D_1$
Feedback
Optimized Catalyst

FIG. 10B



2000-522

FIG. 1A

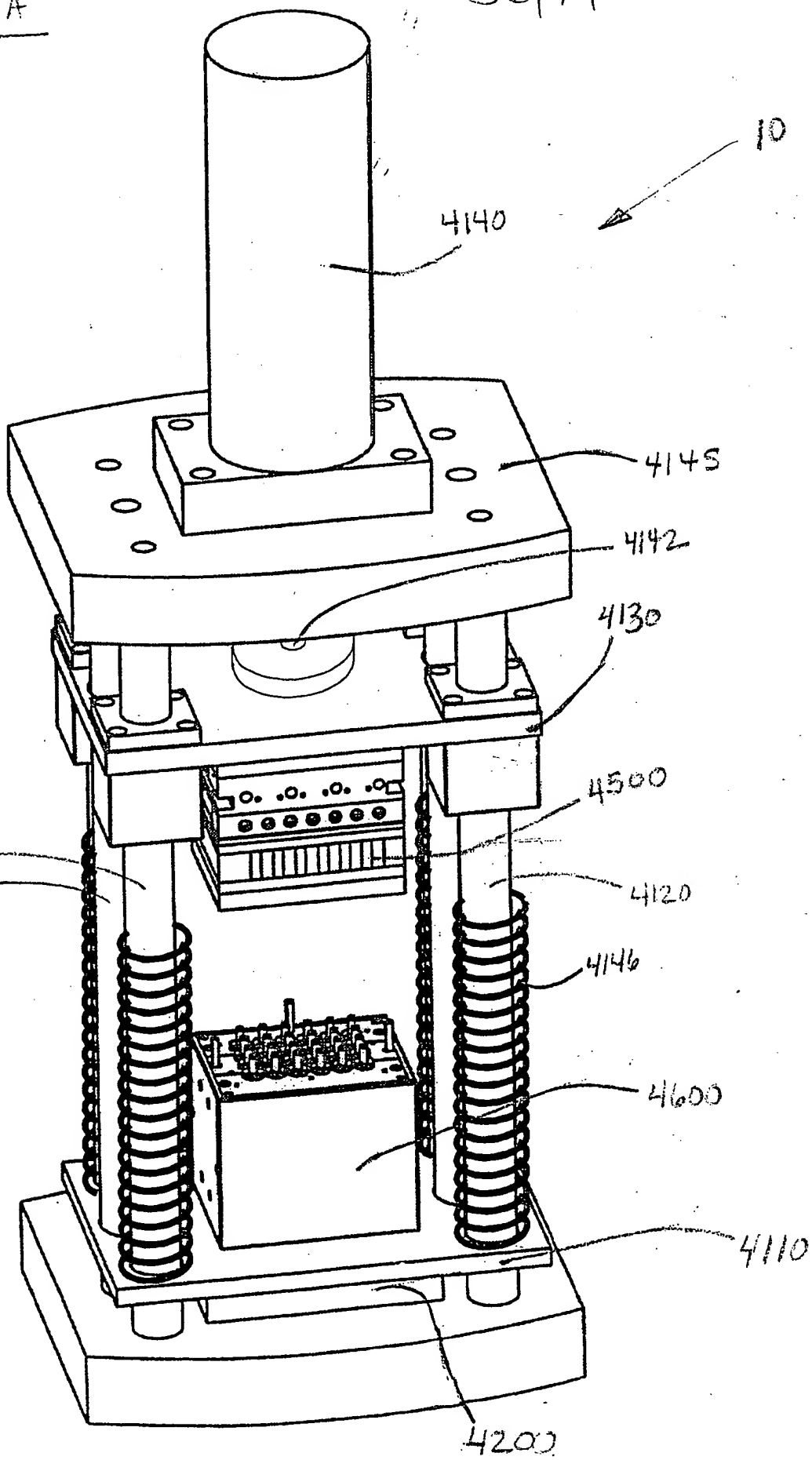


FIG. 11B

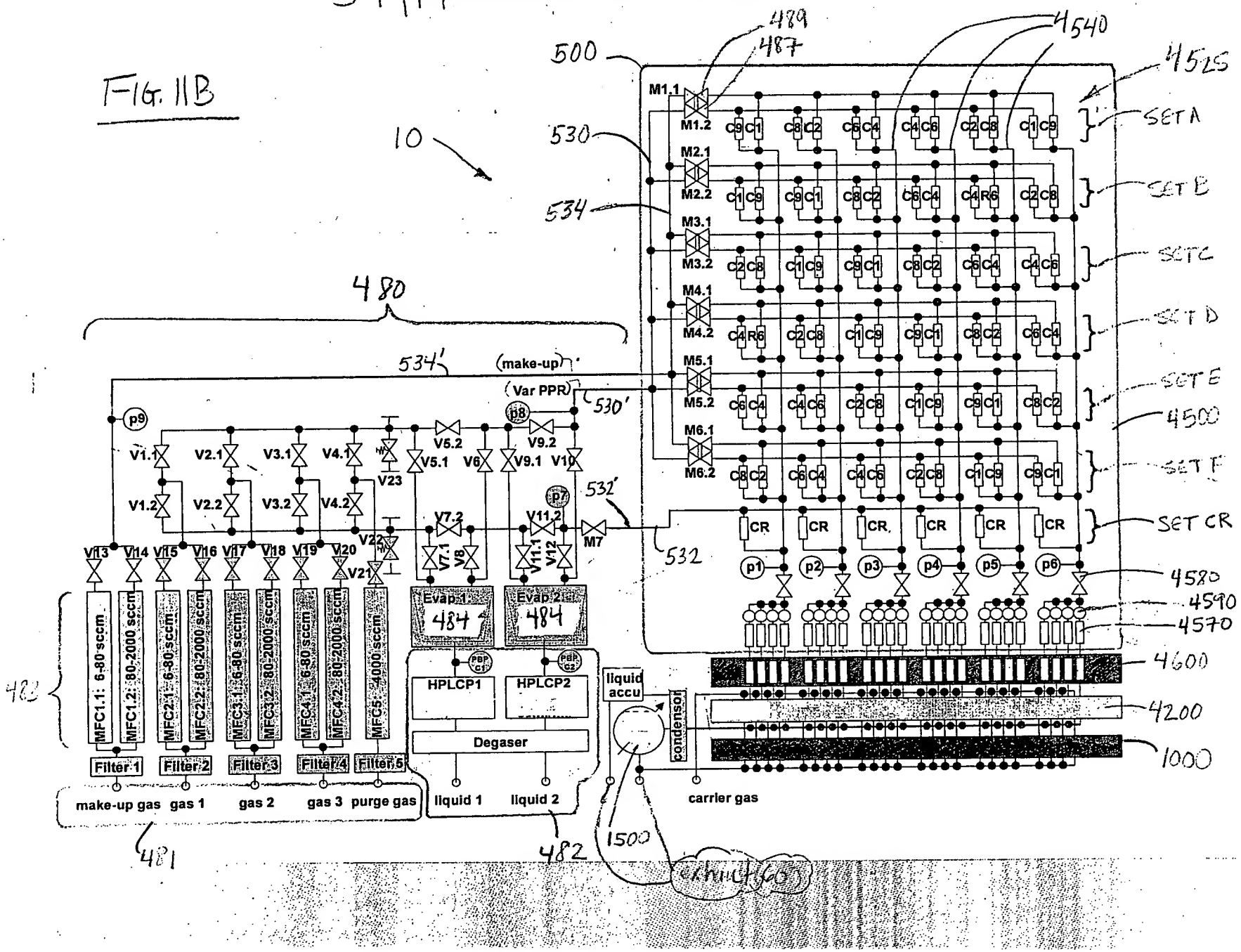

10
500
530
534
480
534'
(make-up)
(Var PPR)
530'
532'
532
M1.1
M1.2
M2.1
M2.2
M3.1
M3.2
M4.1
M4.2
M5.1
M5.2
M6.1
M6.2
SET A
SET B
SET C
SET D
SET E
SET F
SET CR
4500
4525
4540
4580
4590
4570
4600
4200
1000
p1
p2
p3
p4
p5
p6
p7
p8
p9
V1.1
V1.2
V2.1
V2.2
V3.1
V3.2
V4.1
V4.2
V5.1
V5.2
V6
V7.1
V7.2
V8
V9.1
V9.2
V10
V11.1
V11.2
V12
V13
V14
V15
V16
V17
V18
V19
V20
V21
V22
V23
M7
MFC1.1: 6-80 sccm
MFC1.2: 80-2000 sccm
MFC2.1: 6-80 sccm
MFC2.2: 80-2000 sccm
MFC3.1: 6-80 sccm
MFC3.2: 80-2000 sccm
MFC4.1: 6-80 sccm
MFC4.2: 80-2000 sccm
MFC5: 4000 sccm
482
Evap 1
484
Evap 2
484
PBP C1
PBP C2
HPLCP1
HPLCP2
Degaser
liquid accu
condensor
Filter 1
Filter 2
Filter 3
Filter 4
Filter 5
make-up gas
gas 1
gas 2
gas 3
purge gas
liquid 1
liquid 2
carrier gas
481
482
1500
exhaust(GC)

Fig. 11C

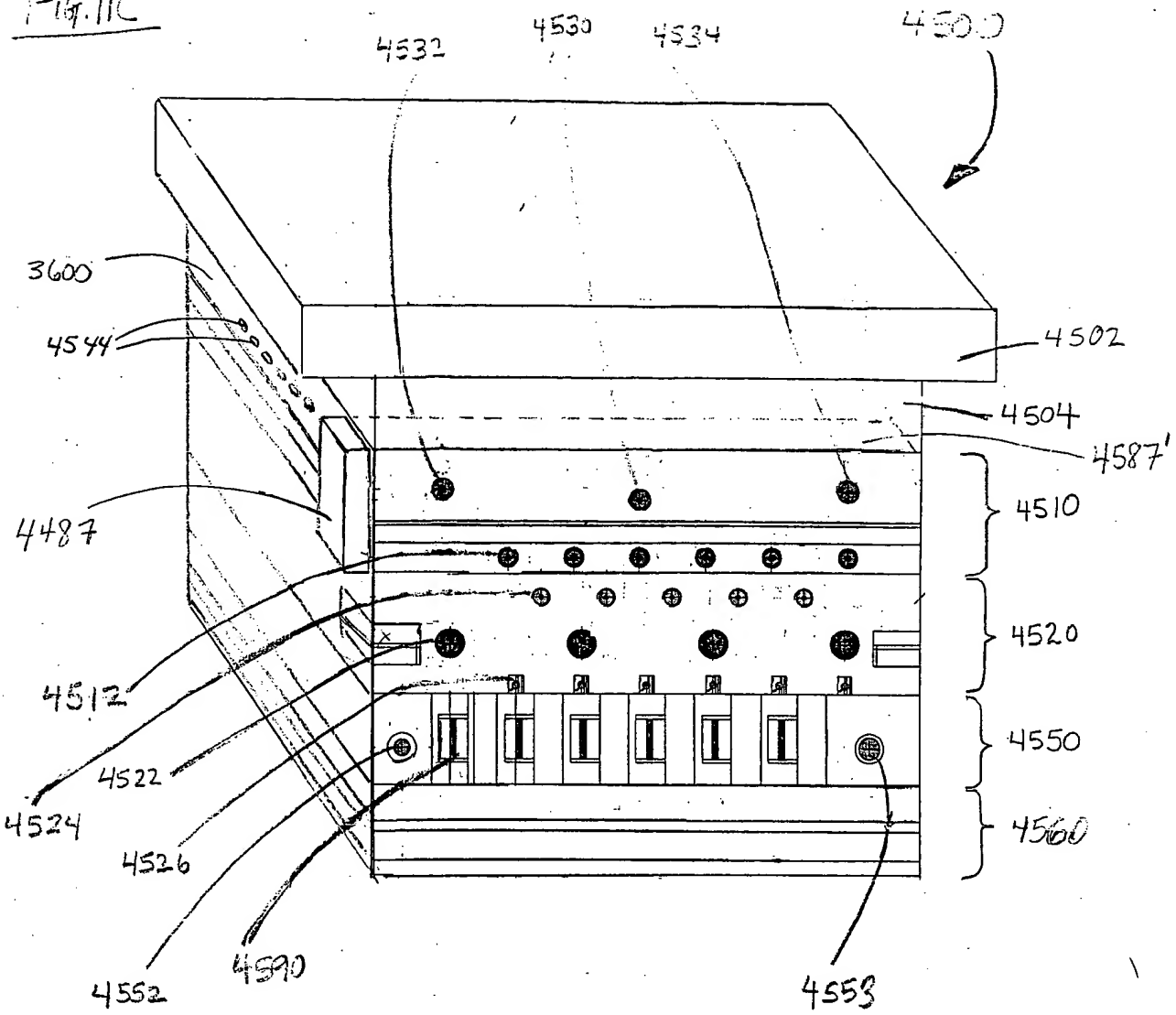

4532
4530
4534
4500
3600
4544
4502
4504
4587'
4487
4510
4520
4512
4522
4524
4526
4550
4560
4552
4590
4553

FIG. 11D

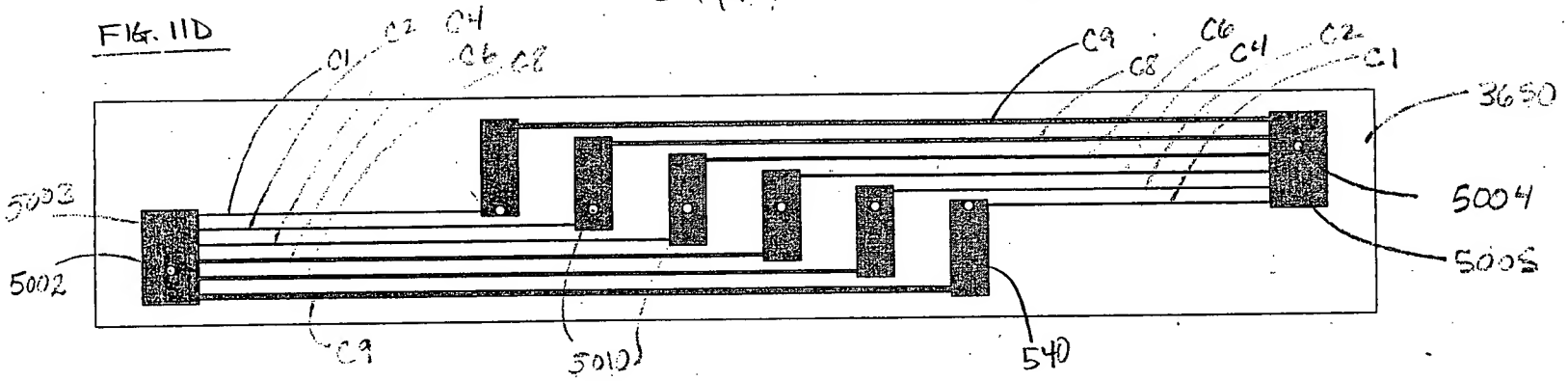


FIG 11E

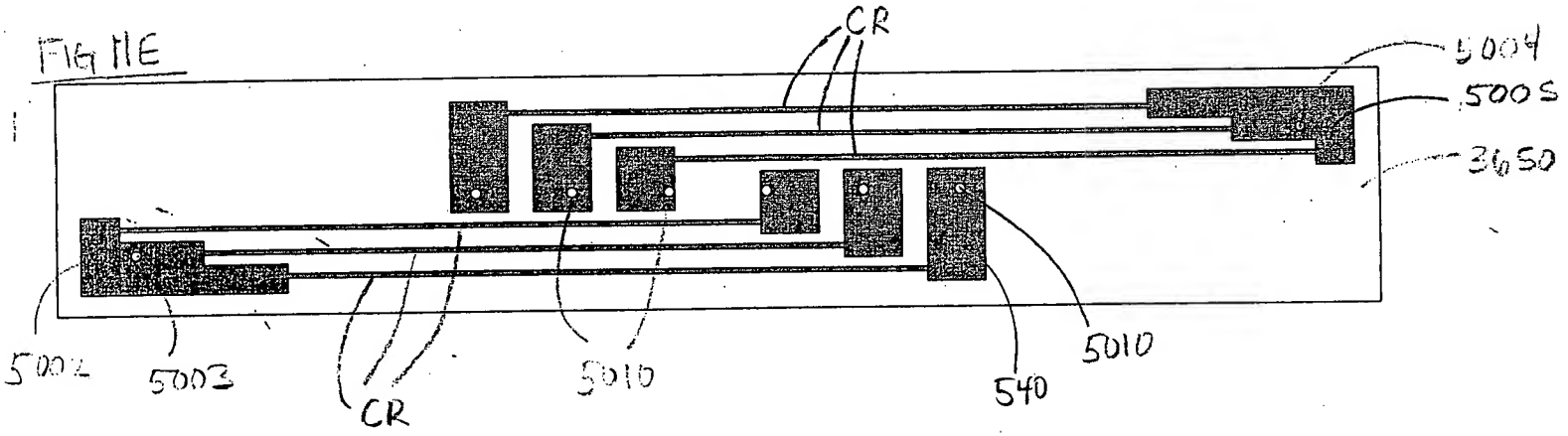


FIG 11F

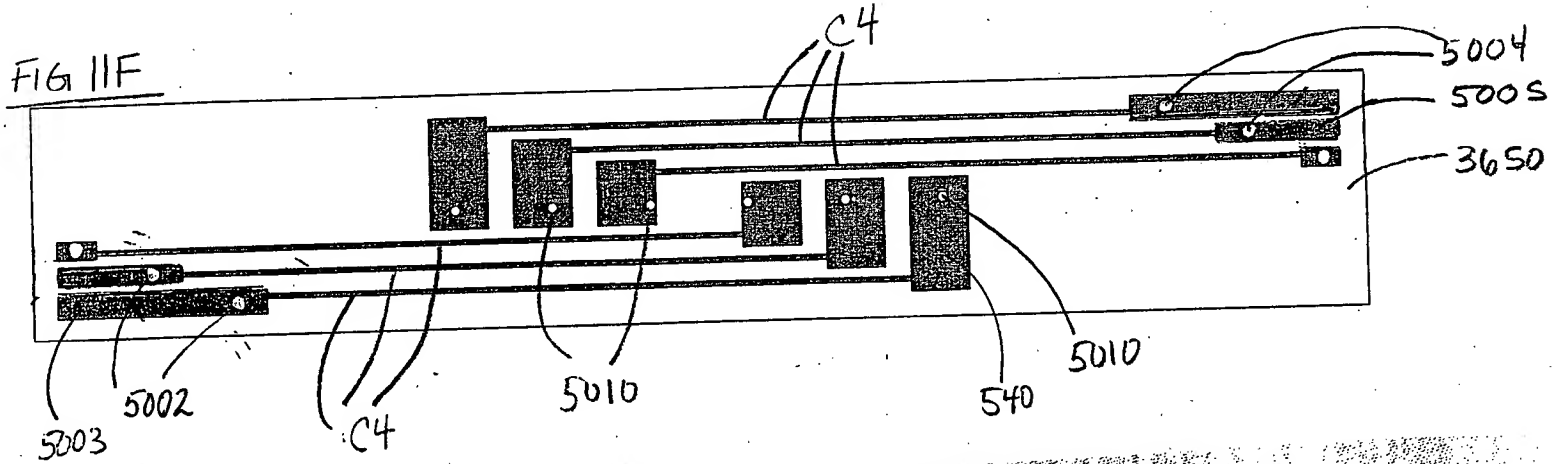


FIG. 11G

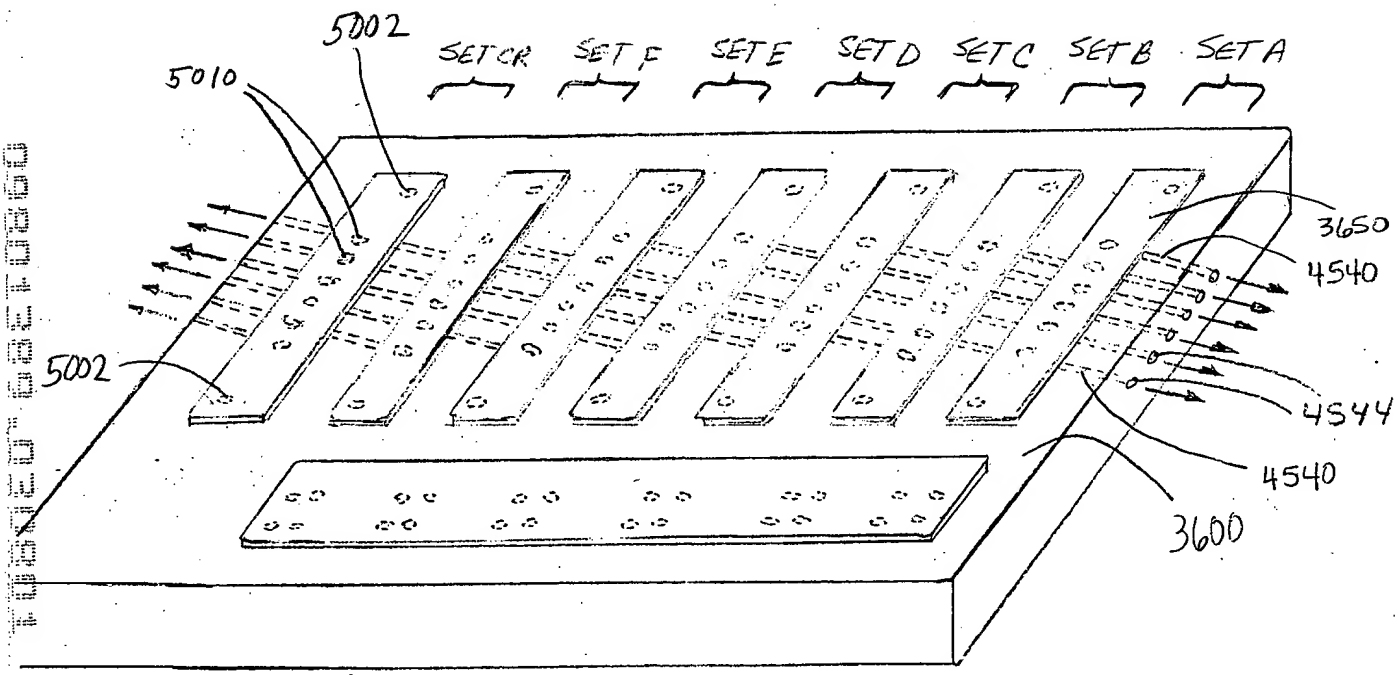

5002
5010
SET CR
SET F
SET E
SET D
SET C
SET B
SET A
3650
4540
5002
4544
4540
3600

FIG. 11H

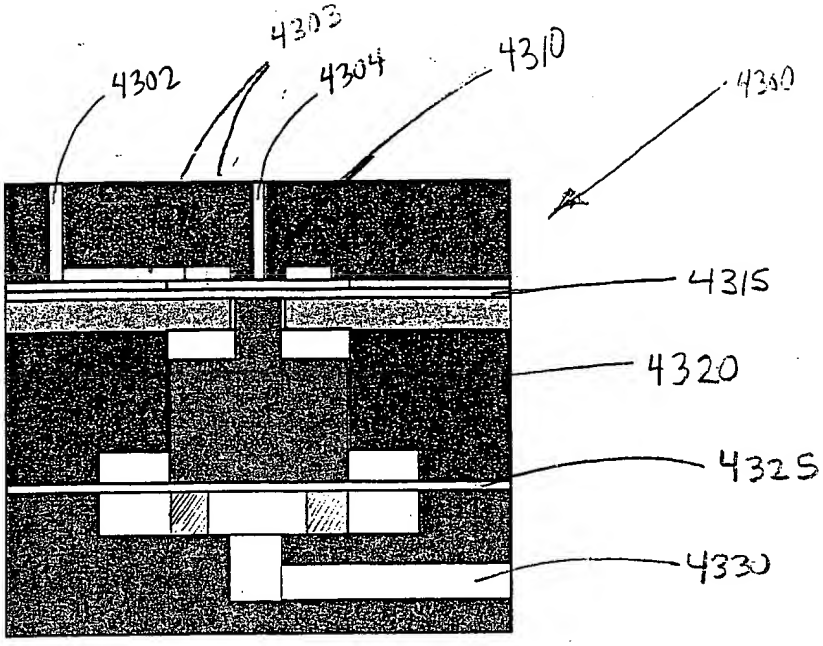


FIG 11I

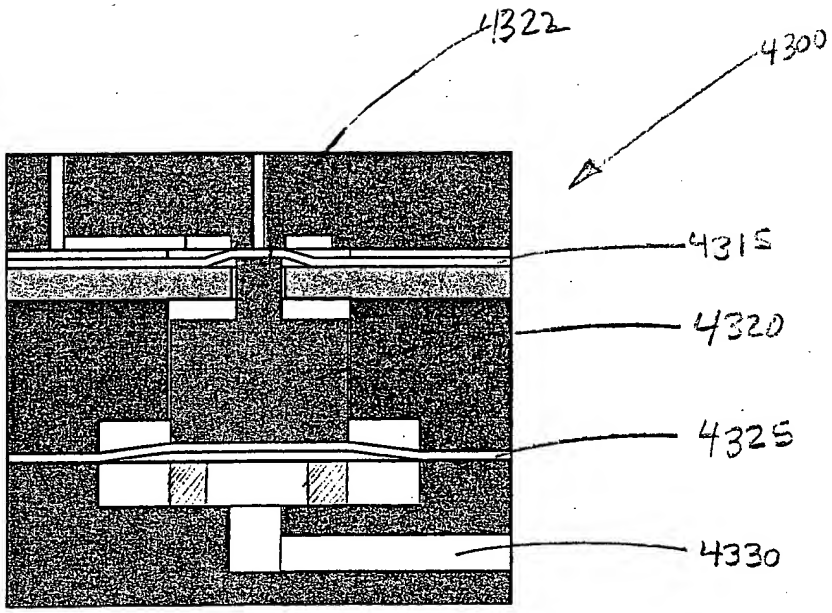


FIG. 11J

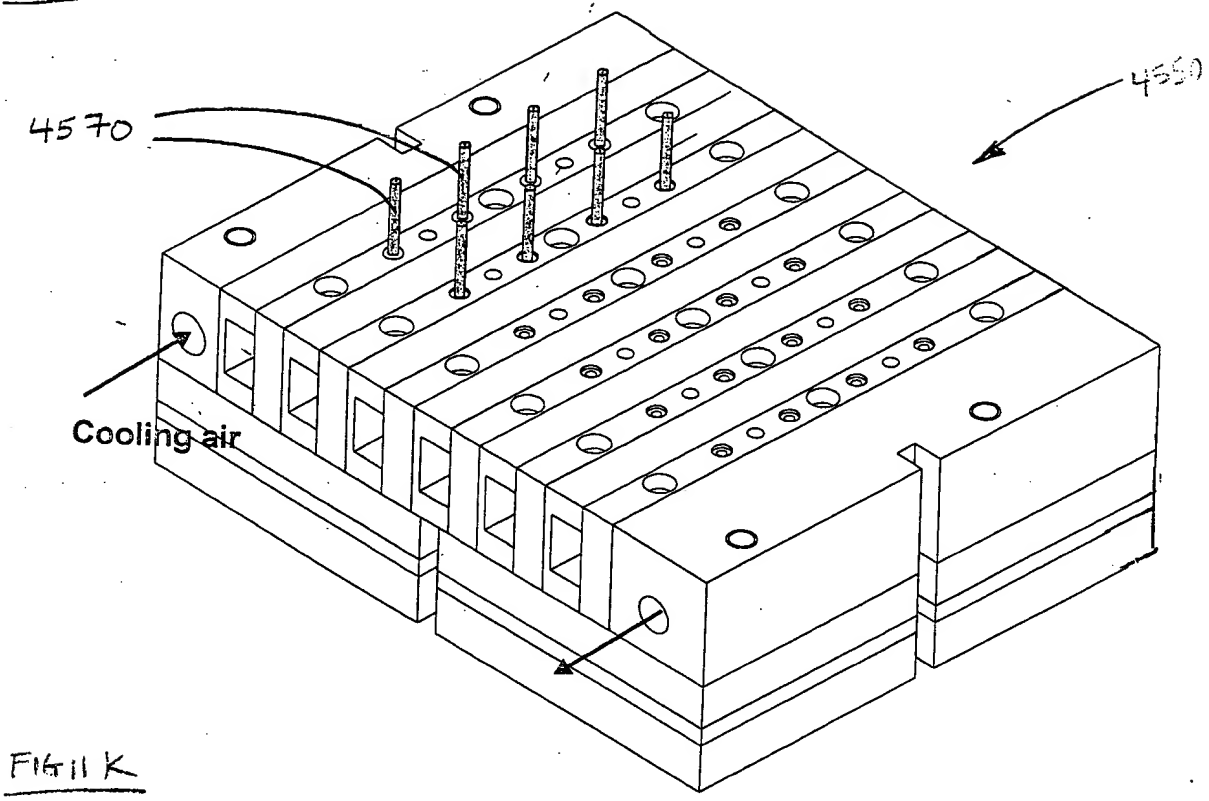


FIG 11K

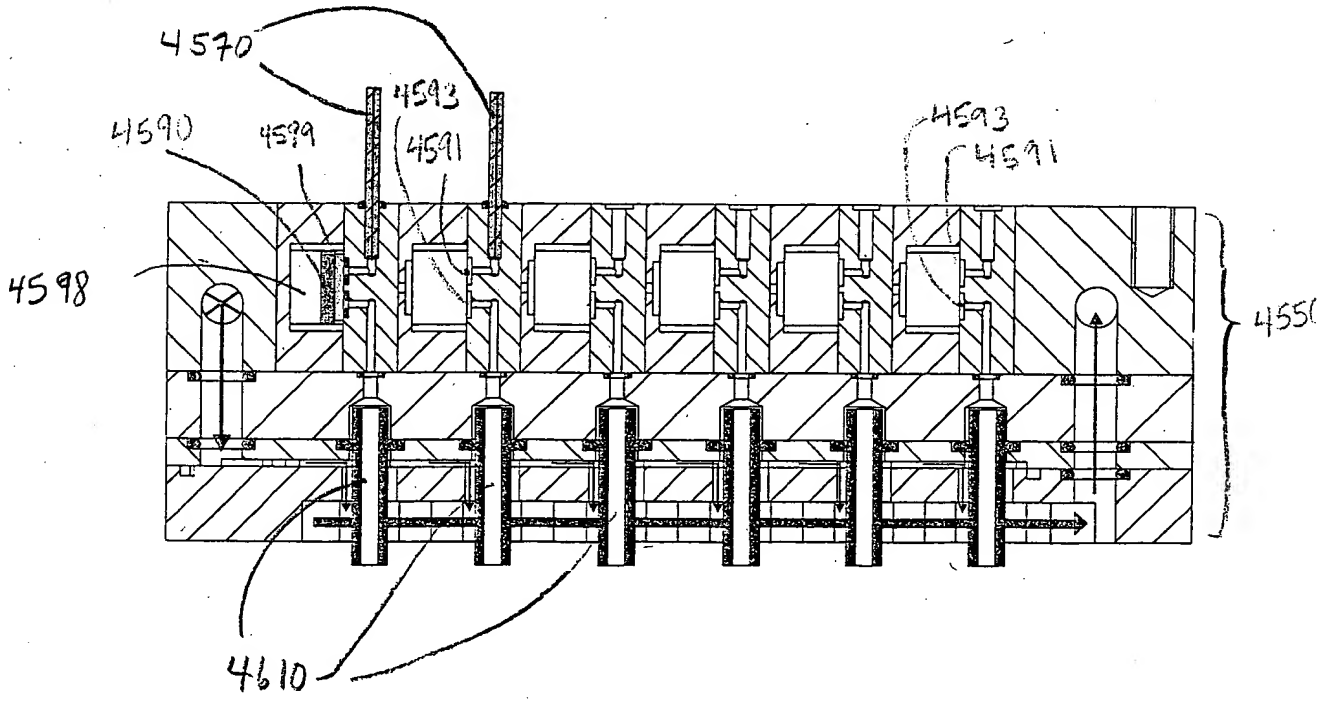


FIG. 11L

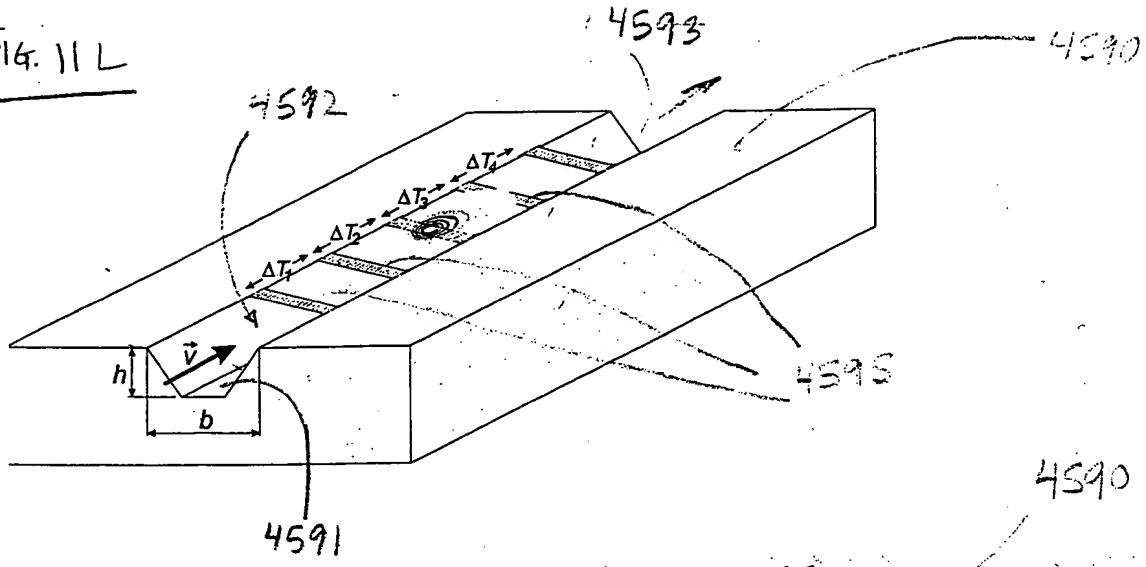


FIG. 11M

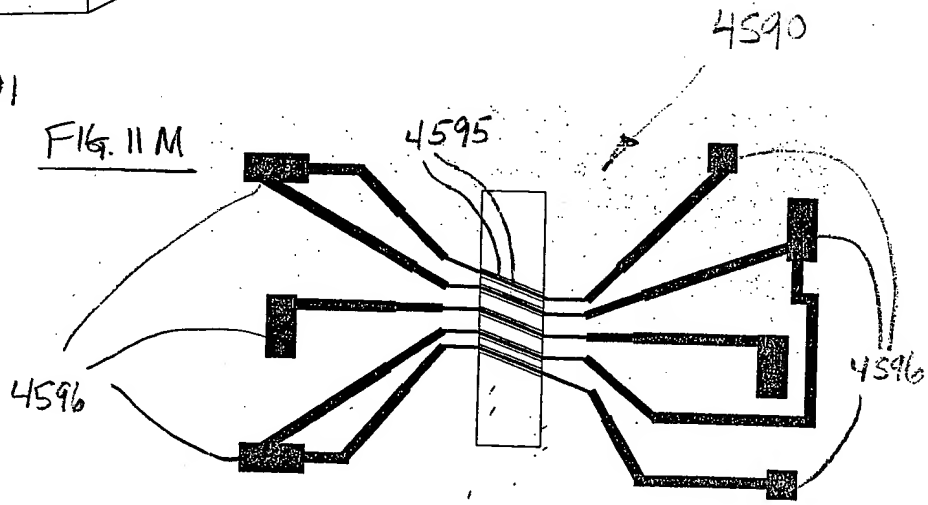


FIG 11N

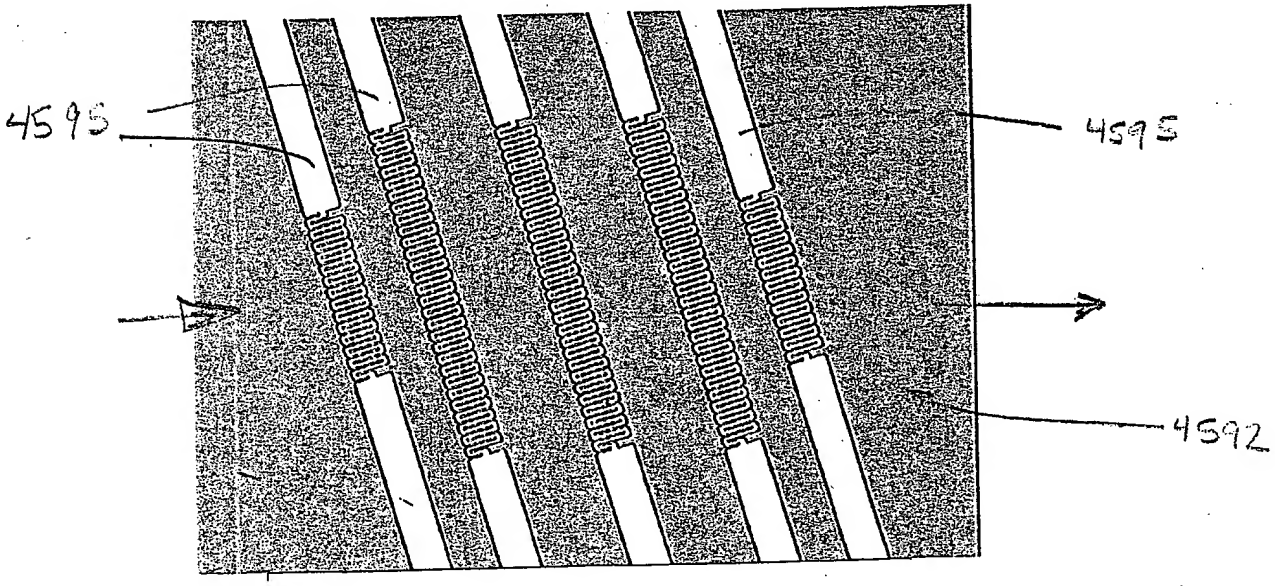


FIG. 110

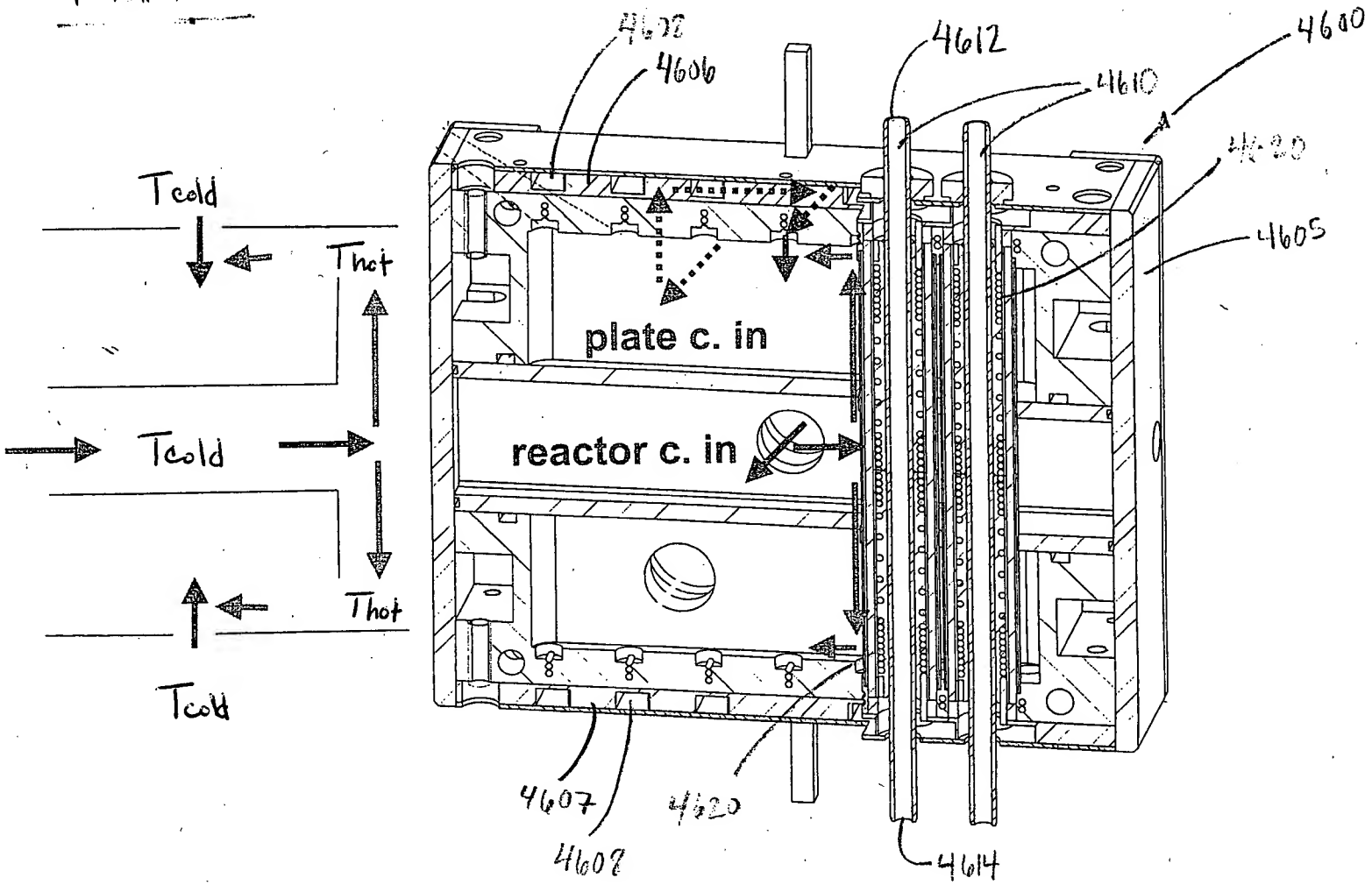

4602
4606
4612
4610
4600
4620
4605
Tcold
Thot
plate c. in
Tcold
reactor c. in
Thot
Tcold
4607
4608
4620
4614

FIG. 12A

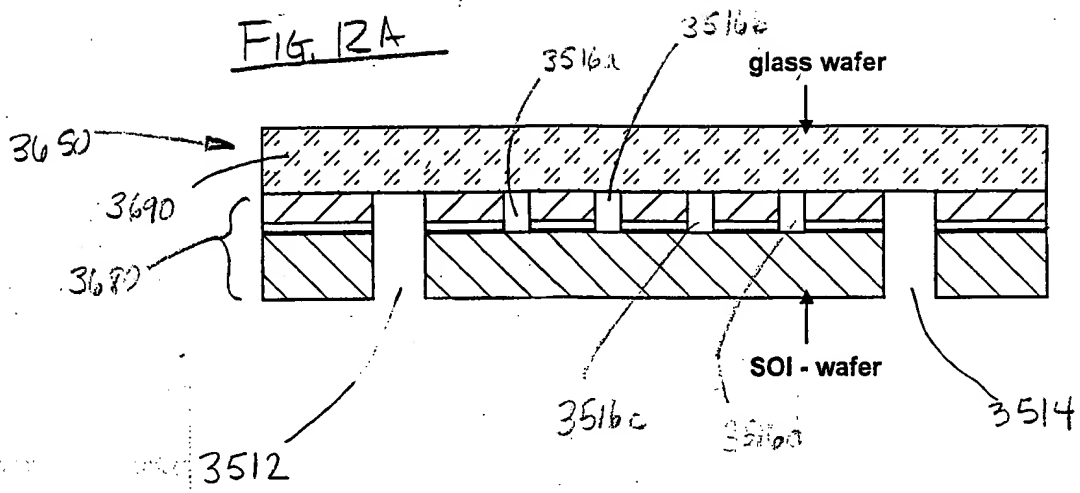

3516a
3516b
glass wafer
3650
3690
3680
SOI - wafer
3516c
3514
3512

FIG. 12B

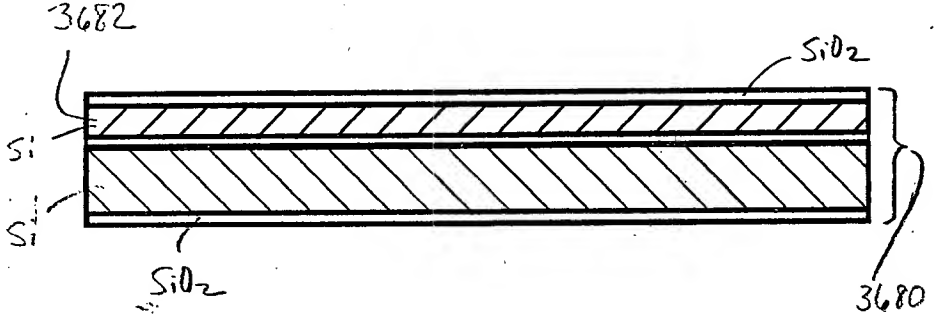


FIG. 12C

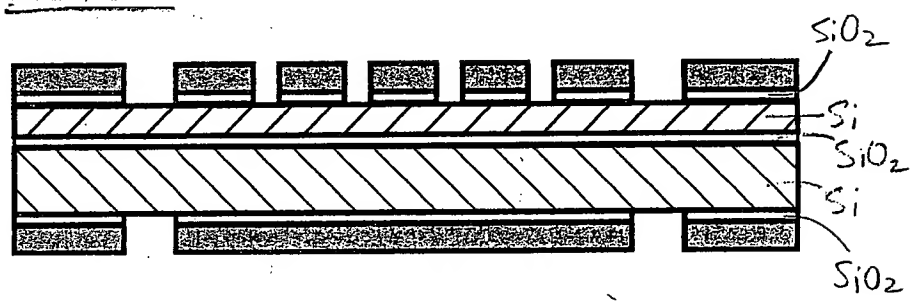


FIG. 12D

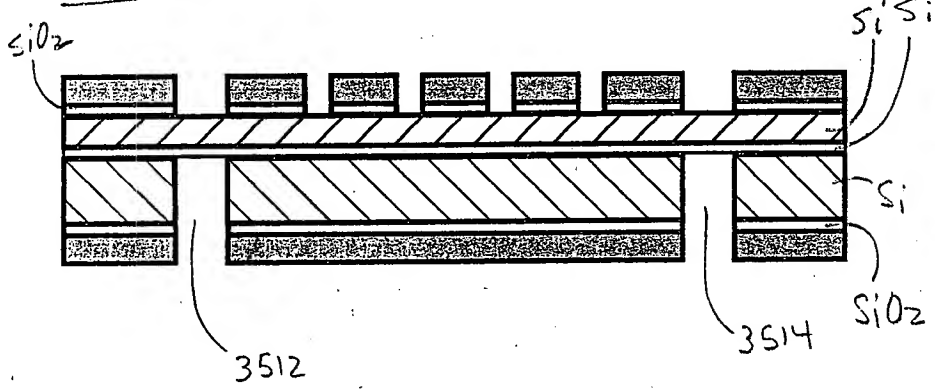


FIG. 12E

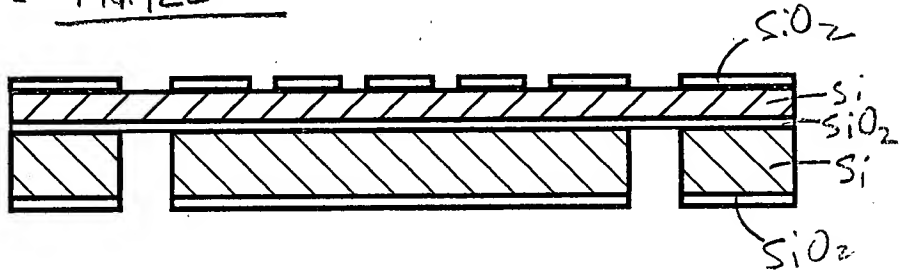


FIG. 12F

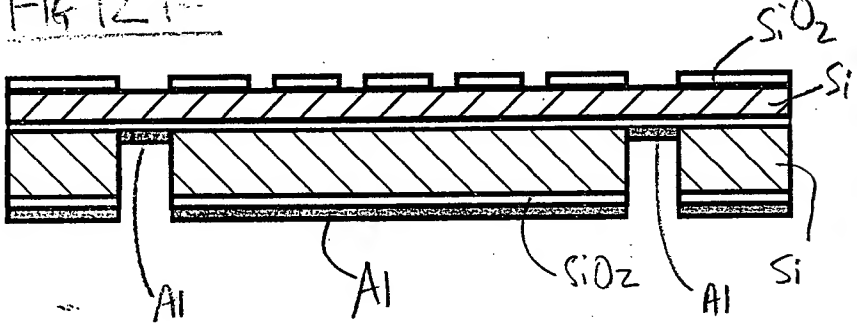


FIG. 12G

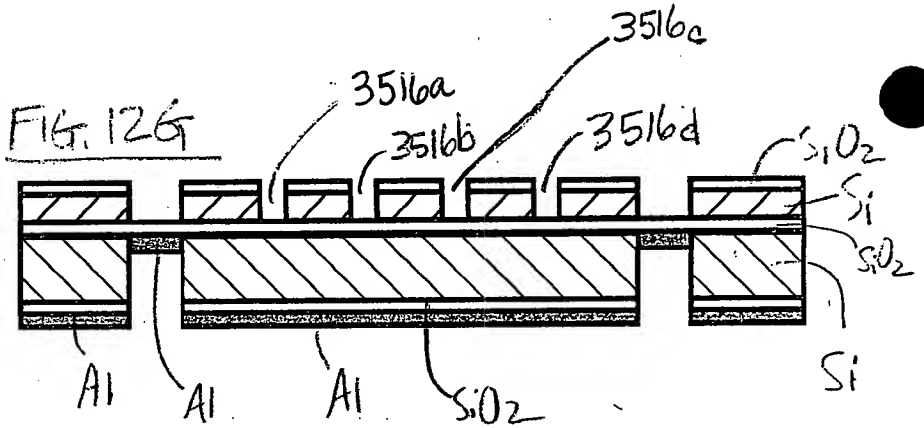


FIG. 12H